W. J. Hammer

from

Thomas A Edison

N York Feby 19th 1885 -

Wm J. Hammer.
from Thos. A. Edison.

Edison, Thomas Alva

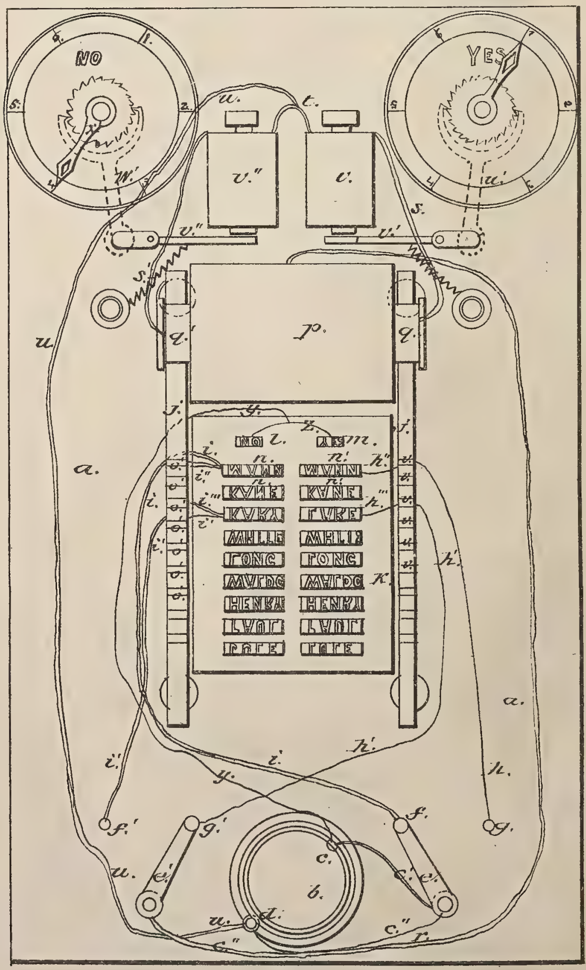
United States Patents of
Thomas Alva Edison [illegible]
[illegible]

Front

T. A. Edison,

Vote Recorder.

No. 90,646. Patented Jun. 1. 1869.



Witnesses:
Carroll D. Wright.
DeWitt C. Roberts.

Inventor.
Thomas A Edison

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO HIMSELF AND DEWITT C. ROBERTS, OF SAME PLACE.

IMPROVEMENT IN ELECTROGRAPHIC VOTE-RECORDER.

Specification forming part of Letters Patent No. **90,646**, dated June 1, 1869.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful apparatus named "Electrographic Vote Recorder and Register," of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, which represents a plan view of the apparatus, and to the letters of reference thereon.

The object of my invention is to produce an apparatus which records and registers in an instant, and with great accuracy, the votes of legislative bodies, thus avoiding loss of valuable time consumed in counting and registering the votes and names, as done in the usual manner; and my invention consists in applying an electrographic apparatus in such a manner that each member, by moving a switch to either of two points, representing an affirmative and opposing vote, has his name imprinted, by means of electricity, under the desired head, on a previously-prepared paper, and at the same time the number of votes is indicated on a dial-plate by the operation.

Referring to the drawings, in the central portion of the plate *a a* is secured a block, *k*, upon which are set, in metallic types, two columns of names, *n n'*, the one being headed by the word "no," the other by "yes," each column containing the name of every voter, and the like names standing opposite each other, as Mann under head "no" opposite to Mann under head "yes," &c. The types are separated by intervening spaces.

Along two sides of the block *k*, and parallel with the two columns *n n'*, are two rails, *j j'*, composed of any good insulating material, as hard rubber.

Opposite the intervening spaces between two names the upper faces of the rails *j j'* are intersected by metallic strips *o o o o' o' o'*.

On the rails *j j'* are mounted two rollers, *q q'*, insulated from one another, and insulated from and surrounded by the cylinder *p*, in such a manner that the rollers *q q'* project beyond said cylinder *p* and rest immediately upon the rails. These rollers are metallic, and the larger one, *p*, is of such a size as to come in contact with a chemically-prepared paper placed upon the types, and is, furthermore, in communication with battery *b* by means of conducting-wire *r r*, or in any other suitable manner.

The rollers *q q'* communicate with the two magnets *v v''* by the wires *s s'*, and through them operate the armatures *v' v'''*, the escapements *w w'* and the pointers *x x'*, which latter show the numbers of votes on the dial-plates marked with as many figures as there are voters.

The battery *b*, with the two poles *c* and *d*, is connected with and operates the apparatus in the following manner: The pole *c* is in constant communication with the metallic types *l m*, representing, respectively, "no" and "yes," by means of the conducting-wires *y z*; but the pole *c* is connected by the wires *c' c'' c''*, with as many switches *e e'* as there are voters.

From the points *f f' g g'* the conducting-wires *i i' h h'* pass to the metallic strips *o o o' o'*, and from thence to the nearest metallic type, or they may pass first to the types and then branch back to the respective strips, as seen in the column to the left.

From the pole *d* of battery *b* communication is established with the cylinder *p* by the wire *r r*, and from the same pole by the wire *u u t* to the two magnets, where the aforesaid conducting-wires *s s'* lead to the two insulated rollers *q q'*.

The apparatus is placed before the recording clerk's desk, and a paper, which is previously chemically prepared for printing by electricity by saturating it in any known solution for that purpose, is placed upon the types, and covering the two columns and their heading.

Every voter is also provided with a switch, *e*, and moves the same *ad libitum*, as the occasion may require, on the point *f* or *g*. Thus an electric current is established between the pole *c* of the battery, the switch *e e'*, and the types *l m*, and the clerk then rolls the rollers *q q'* with cylinder *p* on the paper upon the types. As soon as the cylinder *p* comes on the type of the headings the circuit becomes completed through the paper, (as the wires *y y* connect the pole *c* with the types, and the wire *r* the pole *d* with the cylinder *p*,) and de-

composes the chemicals, thereby discoloring the paper in contact with the types, and thus produces the printing.

When the cylinder *p* comes over the two names—Mann, Mann—the current from pole *c* through switch *e* and wire *i* to the types bearing the name on the left becomes completed through the paper, with cylinder *p*, wire *r*, and pole *d*, and, discoloring the paper, produces the name Mann on the paper; but there is no connection of the other name Mann to the right with the switch and pole *c*; consequently no decomposition takes place, and no name shown.

The roller *p* passing on and leaving the types the circuit becomes broken; but as soon as the rollers *q q′* come in contact with the metallic strips *o o′* the circuit from pole *c* through the switch *e*, wire *i i″*, strip *o′*, and through roller *q′*, magnet *v″*, wire *t* and *u* to pole *d*, becomes closed, the armature *v‴* attracted the escapement *w′*, and with it the pointer *x′* moved forward, and here one negative vote recorded, &c.

Thus, it will be seen, the names of all the voters are printed on their respective heads, and also the whole number of votes counted in an instant, or as long as it will require time to roll the cylinder *p* over the types containing the list of all the names in metallic types, with more dispatch and accuracy than it can possibly be done in any other way.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a switch or switches *e e′*, types and cylinder *p*, with an electric battery, connected and operating substantially as and for the purpose set forth.

2. The combination of switch *e*, strips *o o′*, types, and the separated and insulated rollers *q q′*, magnets *v v″*, armature, escapement, pointer, and dial-plate, with the battery *b*, connected and operated substantially as and for the purpose above described.

3. The combination of switch, types, cylinder *p*, rollers *q q′*, strips *o o′*, and insulators *j j′*, magnets *v v″*, armature, &c., constructed in the manner and for the purpose above specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

THOMAS A. EDISON.

Witnesses:
CARROLL D. WRIGHT,
M. S. G. WILDE.

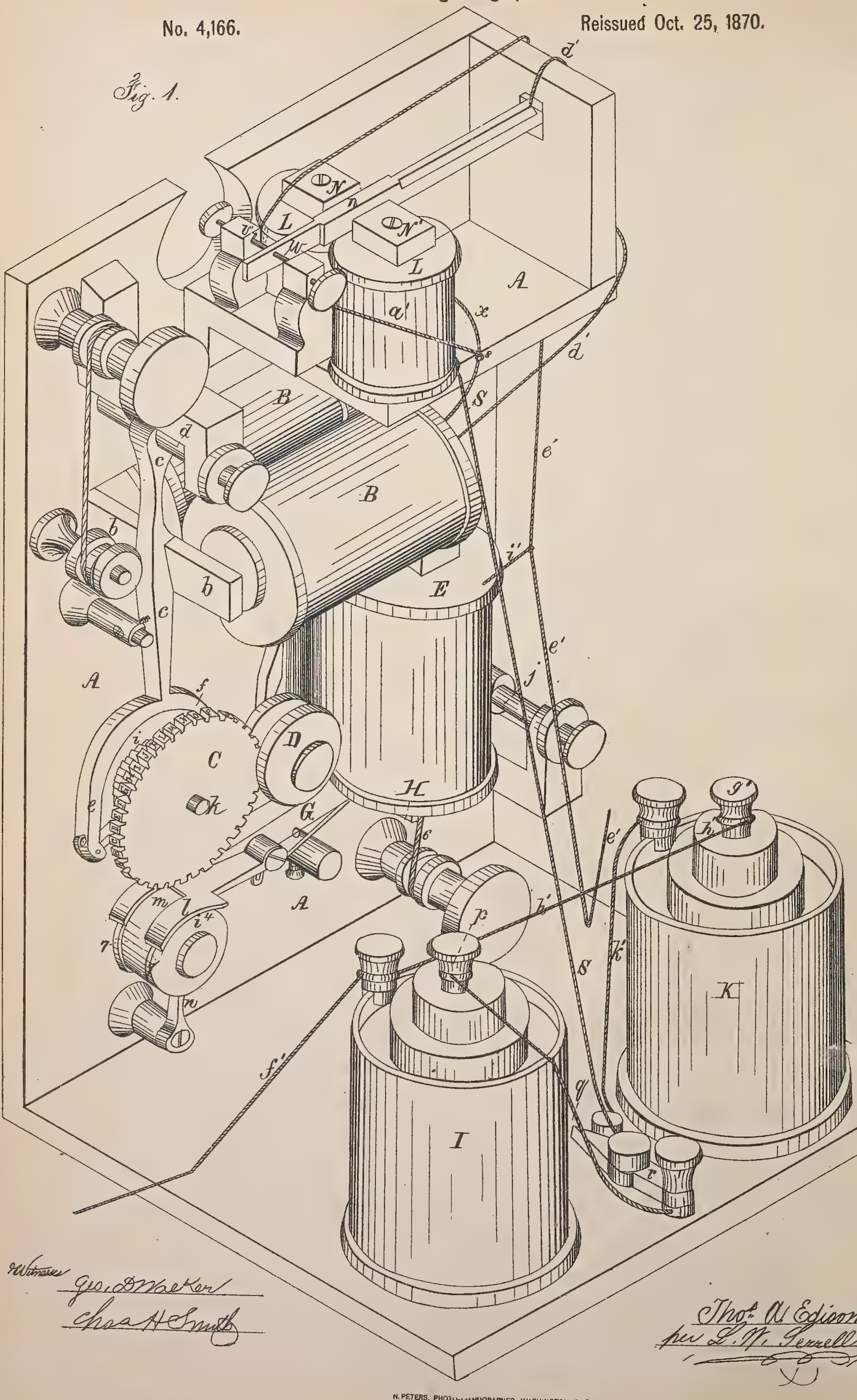
4 Sheets—Sheet 1.

T. A. EDISON.

Printing Telegraph.

No. 4,166. Reissued Oct. 25, 1870.

Fig. 1.



Witnesses Geo. D. Walker

Chas. H. Smith

Thos. A. Edison per L. W. Serrell atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

4 Sheets—Sheet 2.

T. A. EDISON.

Printing Telegraph.

No. 4,166. Reissued Oct. 25, 1870.

Fig. 2.

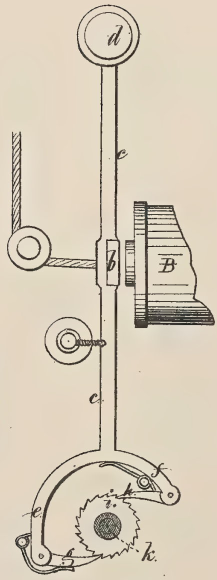
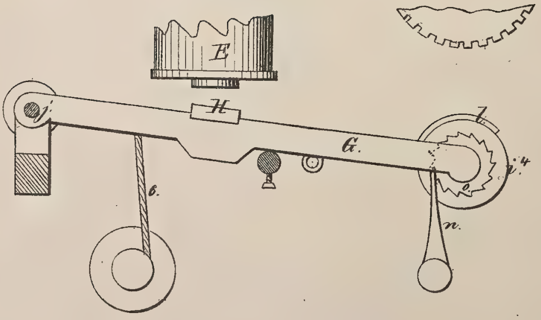


Fig. 3.



Witnesses,

Geo. D. Walker

Chas. H. Smith

Thos. A. Edison.

per Lemuel W. Serrell att'y

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

4 Sheets—Sheet 3.

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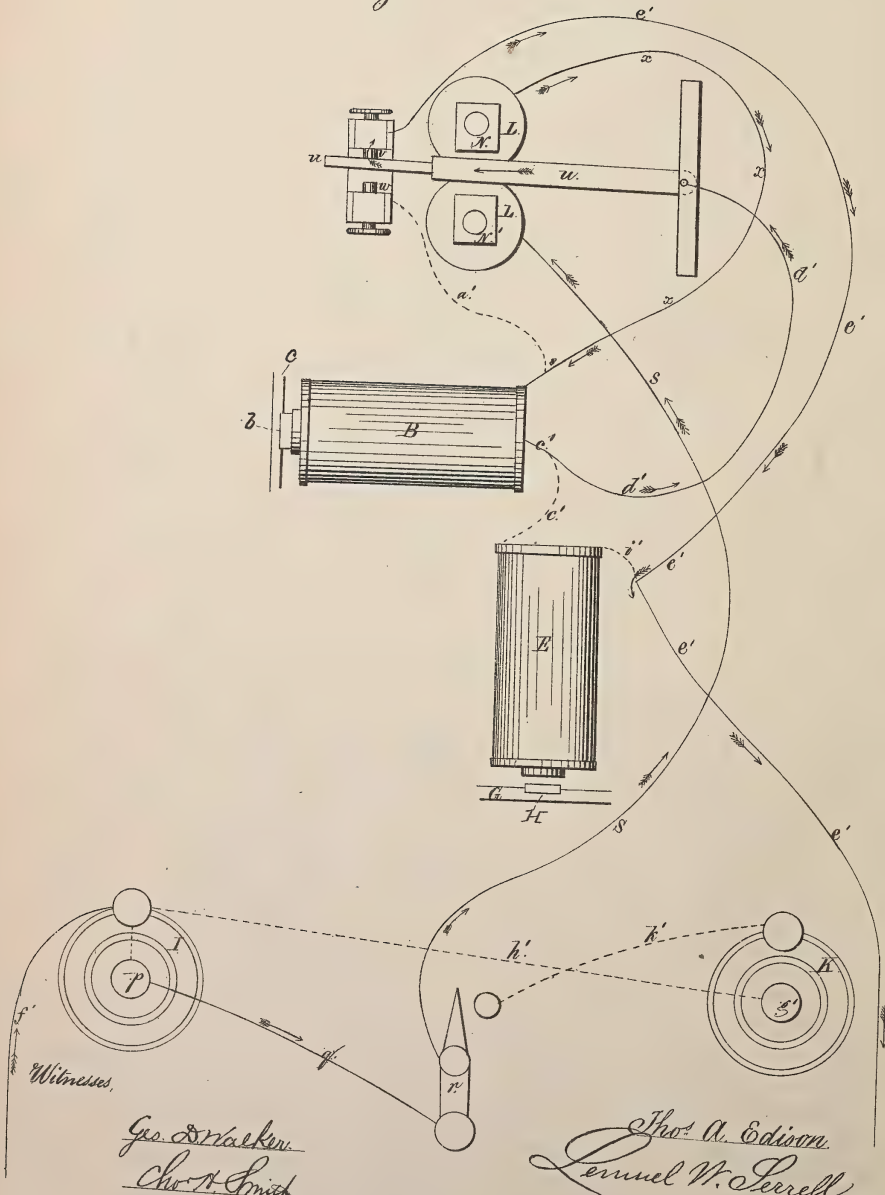
Fig. 4.



Witnesses,

Geo. D. Walker.
Chas. H. Smith

Thos. A. Edison.
Lemuel W. Serrell atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

T. A. EDISON.

4 Sheets—Sheet 4.

Printing Telegraph.

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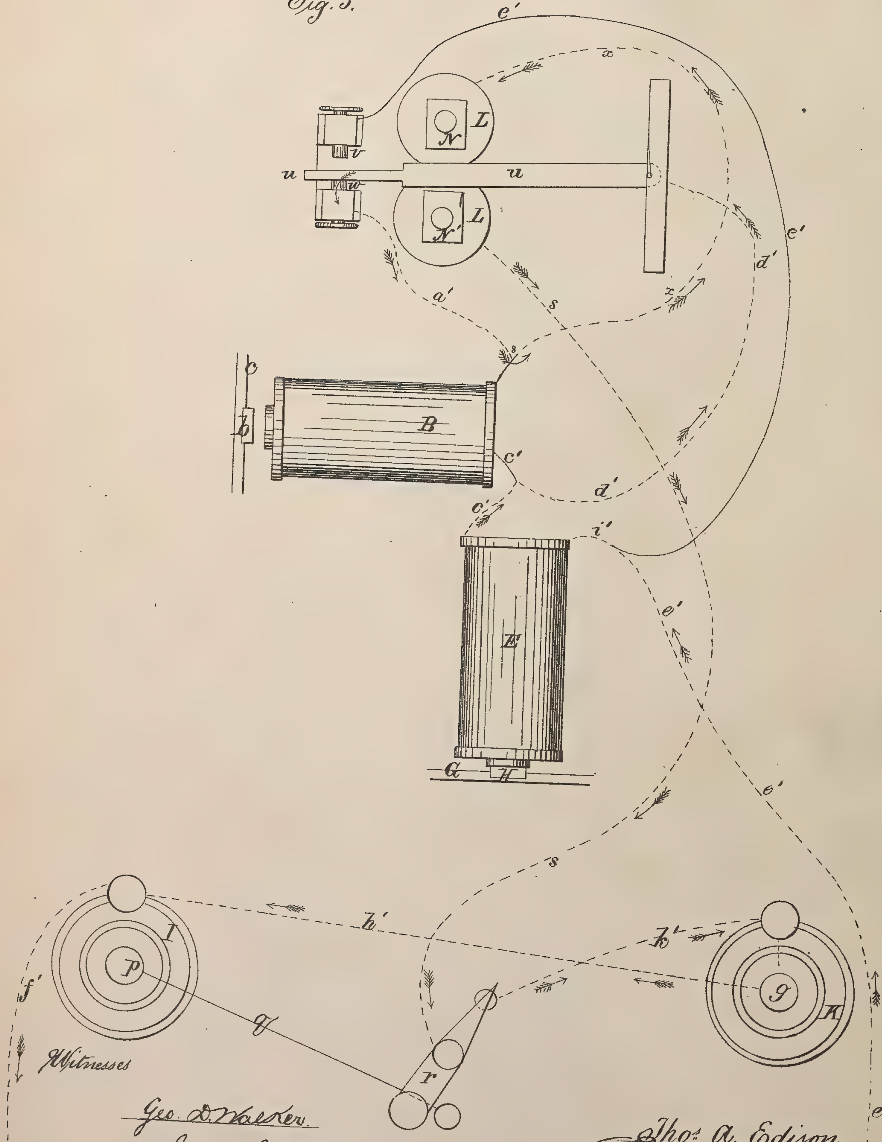
Fig. 5.



Witnesses

Geo. D. Walker.

Chs. H. Smith

Thos. A. Edison

Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE GOLD AND STOCK TELEGRAPH COMPANY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 91,527, dated June 22, 1869; reissue No. **4,166**, dated October 25, 1870.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, now of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, and the following is declared to be a correct description of the same.

This invention relates to a printing-telegraph in which an electro-magnet is employed for setting the type-wheel by a step-by-step movement, and another magnet is used for giving the impression upon the strip of paper; the special feature of my invention consisting in the combination of the foregoing parts with a circuit-changer actuated by the polarity of the current, so that the instrument at the receiving-station is under the control of the operator at the transmitting-station, and, when pulsations of one polarity are sent, the circuit-changer causes said pulsations to operate to set the type-wheel, the printing-magnet and its branch-circuit being cut out; and, when a pulsation of the opposite polarity is sent, the circuit-changer is moved so that the branch-circuit to the printing-magnet is closed and the circuit to the type-wheel magnet is rendered inoperative. By this means one wire may be used for operating the printing-telegraph, and several machines in one main line may be simultaneously operated, and no attendants are required at the receiving-stations; weights, springs, and clock-work are not required, and each current acts with its full force upon the electro-magnet to which it is directed in the branch circuit, so that local batteries or relay-magnets are rendered unnecessary. I also make use of a double-acting escapement with a type-wheel printing mechanism and electro-magnet, operated by the main circuit, whereby both the breaking and closing stroke of the armature assist in the movement of the type-wheel.

In the drawing, A represents the frame of the apparatus, to which is attached an electro-magnet, B B, of the usual construction. C is a type-wheel, whose periphery is provided with suitable letters or other characters, which revolve upon a stud or shaft, *k*. The armature *b* of the electro-magnet B is attached to a lever, *c*, suspended upon an arbor, *d*. The lower end of the lever *c* is bifurcated, as seen in Figures 1 and 2, the two arms *e f* carrying pawls *g h*, which engage at opposite points upon the periphery of the ratchet-wheel *i*, which is fixed upon the same shaft as the type-wheel C, and revolves with it. It will be understood, by reference to Fig. 2, that each vibration of the lever *c* backward or forward will cause the ratchet-wheel *i* to advance in its revolution the distance of one tooth in the same direction. The type-wheel C receives its supply of ink from the roller D in any well-known manner. The electro-magnet E is similar to the electro-magnet B, and is attached to the frame A. The armature H, Fig. 3, is attached to the lever G, Figs. 1 and 3, which swings upon its axis at *j*, and is provided at its opposite extremity with a roller, i^4, which occupies a position immediately beneath the type-wheel C. The strip of paper upon which the communications are to be printed is led from a suitable reel, not shown, over the roller i^4, upon which it is held with a sufficient degree of friction by a spring-arm, *l*, provided with an open slot, *m*, so that, when the roller i^4 is raised by the action of the electro-magnet E upon the lever G, the strip of paper is brought in contact with whatever letter or character may at that time be opposite upon the type-wheel C, thereby printing the impression of said letter or character upon the paper. When the action of the electro-magnet E ceases, the lever G is drawn back to its original position by a spring, 6. After each impression has been made, the strip of paper is moved forward by means of a pawl, *n*, which, when the lever G is drawn back, engages with the teeth of a ratchet-wheel, *o*, Fig. 3, which is secured to the roller i^4, causing the said roller to revolve and draw the paper forward a sufficient distance to produce the required space between the letters. The edges 7 of the roller i^4 are roughened to prevent the paper from slipping during the movement.

The arrangement of the electrical connections, and the manner in which either of the electro-magnets B or E may be operated while the other is caused to remain inactive, will now be described, reference being had particularly to Figs. 1, 4, and 5.

I and K are two voltaic batteries, which may be of any suitable construction. The positive pole of the battery I and the negative pole of the battery K are shown as connected to ground or earth wires f' h', and their opposite poles to a key, r, which is so arranged that either the positive pole of K or the negative pole of I may be placed in connection with the line-wire s at pleasure.

The apparatus just described is supposed to be situated at the transmitting-station, and the line-wire s to extend to the receiving-station, where the printing apparatus is supposed to be placed.

The arrangement of the connection at the receiving-station is as follows: L is a small electro-magnet, with a circuit-changer or permanently-magnetized bar, u, pivoted in such a position that one of its extremities is free to vibrate as acted upon by the poles N N′ of the electro-magnet L, its movement, however, being limited by the contact-screws v and w. The circuit-changer or bar u is to be made of magnetized steel or of soft iron, of a character to be moved by the change in the polarity of the electro-magnet. By a well-known law of magnetic action, when an electric current passes through the helices of the electro-magnet L, the bar u will be attracted by one of its poles and repelled by the other; and when the said current is reversed, or, in other words, changed from positive to negative, or from negative to positive, the bar will be attracted by the opposite pole, and repelled by the pole which in the first place attracted it.

The manner in which this action is applied to the operation of the apparatus will now be explained. Referring to Fig. 4, suppose the battery I to be placed in connection with the line-wire s by means of the key r, the current from the negative pole p passes, as indicated by the arrows, by the wire q to the key r; thence, by the line-wire s, through the electro-magnet L; thence, by the wire x, to the point 8, where a branch, a, goes to the contact-point w; but as the circuit is interrupted at this point, the current goes through the electro-magnet B, which actuates the type-wheel. After passing through B two routes are open to the current, one by wire c', electro-magnet E, and wire i', and the other by wire d', bar or "switch" u, contact-point v, and wire e'. As the latter route offers a very small resistance compared with that through E, the current will take this route in preference, as shown by the arrows, and the electro-magnet E will remain inoperative.

The circuit, after being completed as above described, may be alternately broken and closed by means of an ordinary transmitter, (not shown,) for the purpose of operating the armature b, and thereby rotating the type-wheel C, the mechanism connected with which is so arranged that the circuit requires to be closed and broken once in order to move the wheel C a distance equal to that between two successive letters or characters. This insures the circuit being open whenever a letter is brought into position to allow of its impression being taken off upon the strip of paper.

When the type-wheel has been rotated (by operating the transmitter) until the desired letter or character has been brought into position opposite the roller i^4, the current is reversed by shifting the key r into the position shown in Fig. 5, which disconnects the battery I, and causes the current from the positive pole g' of the battery K to pass through the line-wire s. Upon reaching the receiving-station it will, for an instant, take the same course as before; but its action upon the electro-magnet L being reversed, the bar or circuit-changer u will be attracted to its opposite pole, so as to come in contact with the point w, instead of the point v, as in Fig. 5. The action of an electro-magnet upon a polarized or permanently-magnetic bar being much quicker than upon an ordinary armature of soft iron, the lever u will be shifted from the point v to the point w before the electro-magnet B has time to act. As soon as the bar or circuit-changer u comes in contact with the point w, the current will pass, as indicated by the dotted lines and arrows, Fig. 5, by the wires h' f' c' i' to the electro-magnet E of the printing-hammer, and thence (instead of passing through the electro-magnet B) by the shortest course through the wires c' d', to the tongue u; thence, by the contact-pin w and wires a' x to the electro-magnet L, and by the wire s, key r, and wire k', to the zinc-pole of the battery K, completing the circuit, and causing the armature H to be attracted to the magnet E, raising the lever G, and bringing the paper into contact with the letter on the type-wheel, as required. The key r is then moved back into position, (seen in Figs. 1 and 4,) which again reverses the current and causes it to take the course first described through the electro-magnet B of the type-wheel, but not through the electro-magnet E, the armature of which ceases to be attracted, when the lever G, with the roll i, is drawn down by the spring 6, and the paper fed forward to receive the next impression, as required, when the operation continues as before.

It will thus be seen that, by the employment of a circuit-changer, as above described, either one of the electro-magnets B or E may be brought into action, and the other cut out of the circuit at pleasure, by the reversal of the current, which enables me to greatly simplify the construction of printing-telegraphs, and reduce their cost.

The above-described invention is designed particularly for transmitting intelligence from a central station to a number of receiving-stations included in the circuit, in which case no batteries or operators will be required at the receiving-station; but if messages are to be sent from each station, as well as received, then each instrument will require to be provided with a transmitting-instrument, a battery, and an ordinary switch, connected with a ground wire.

I claim as my invention—

1. A circuit-changer, in combination with an electro-magnet and the type-wheel, and an electro-magnet and the printing mechanism, substantially as set forth, whereby the current is directed through either magnet, according to the polarity of the current, substantially as set forth.

2. A polarized bar, permanent magnet or circuit-changer, and an electro-magnet to move the same, in combination with an electro-magnet placed in the same circuit, and brought into or thrown out of that circuit, according to the polarity of the current and the consequent position of the said permanent magnet, substantially as set forth.

3. The combination of a polarized bar or circuit-changer with two electro-magnets, operated by a main circuit, substantially as specified, whereby either of the two electro-magnets may be brought into action at pleasure, by the use of a positive or a negative current, the other electro-magnet being at the same time inoperative, substantially as set forth.

4. Two or more printing-telegraph instruments placed in one main circuit, and operated simultaneously by pulsations of electricity, the type-wheel being set by pulsations of one polarity, and the printing being effected by pulsations of the opposite polarity, substantially as set forth.

Dated this 6th day of September, A.D. 1870.

THOMAS A. EDISON.

Witnesses:

CHAS. H. SMITH,

GEO. T. PINCKNEY.

T. A. EDISON.

Telegraph Switch.

No. 96,681. Patented Nov. 9, 1869.

Fig. 1.

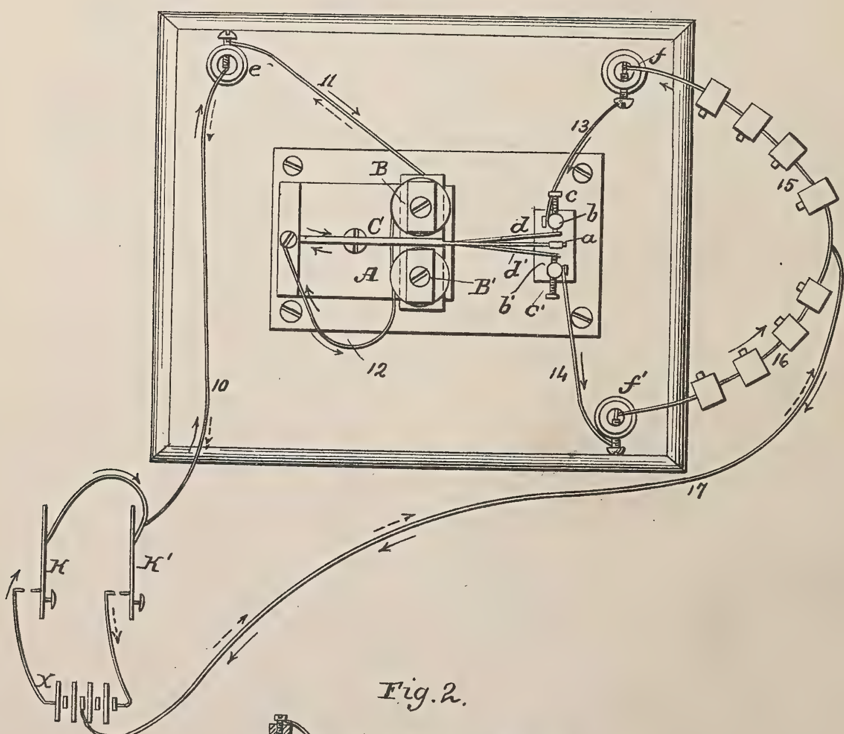
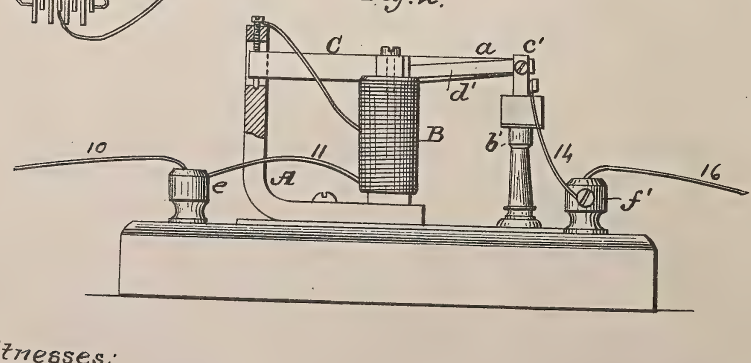


Fig. 2.



Witnesses:

W. Hardy

C. Wahlers

Inventor:

Thomas A. Edison

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEW YORK, N. Y.

AUTOMATIC ELECTRICAL SWITCH FOR TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **96,681**, dated November 9, 1869.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of the city, county, and State of New York, have invented a new and useful Improvement in Automatic Electrical Switches; and I do hereby declare the following to be a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which drawing—

Figure 1 represents a plan or top view of this invention. Fig. 2 is a longitudinal section of the same.

Similar letters indicate corresponding parts.

This invention relates to a certain novel arrangement of branches of one line of wire, in combination with a vibratory armature and its polarized switch-magnet, in such a manner that by passing a current through the coils of the switch-magnet in either direction, *i. e.*, positive or negative, the polarity of one of the poles thereof is neutralized, and the other is augmented and attracts and holds the vibratory armature, so that one of the branch wires, or sets of branch wires, is automatically switched out of the circuit, and the whole current is made to pass with undivided and undiminished force through the other branch wire or wires, whose connection is formed and maintained by the armature, and thus one single current, by reversal, can be made to pass, without any diversion or loss, indifferently through one branch wire, or set of branch wires, and another, at the will of the operator. For instance, one branch may be used for operating a type-wheel, and the other for printing therefrom in a printer, or for operating two different machines, or for effecting advance and retrograde movements in the same machine, and in a great variety of other ways, so that one circuit has, in many useful respects, the power of two ordinary ones.

The "polarized switch-magnet," which I use in carrying out my present invention, is similar to the "polarized relay," described in Letters Patent for a printing-telegraph, granted to me June 22, 1869, and numbered 91,527.

The polarized switch-magnet consists of a permanent magnet, A, bent in the form of the letter L. On the horizontal shank of this L-shaped magnet are secured the cores of two electro-magnets, B B′, while the upright shank of the permanent magnet forms the bearing for the vibrating armature C, which extends through between the ends of the electro-magnets B B′, and is so arranged that it can freely vibrate between said ends or poles and be attracted by either one or the other, as will be presently explained.

From the armature C extends an arm, *a*, through between the posts *b b′*, which carry adjusting-screws *c c′*, and to the sides of the arm *a* are secured weak springs *d d′*, so that if the armature is in a central position said springs will be in contact with the points of both the screws *c c′*; but as soon as the armature, attracted by either core of the electro-magnet, passes this central point in its transition, the contact between one of the springs *d* or *d′* and the corresponding screw *c* or *c′* will be broken.

It is obvious that if the upright shank of the permanent magnet represents the north pole, and the horizontal shank the south pole, the polarity of both soft-iron cores of the electro-magnet will also be south, while the polarity of the soft-iron vibratory armature will be north; but if an electric current is passed through the electro-magnet B B′, which, by its own action, would convert the core of B into the north pole, and the core of B′ into the south pole, the polarity of the core B received from the permanent magnet will thereby be neutralized and the polarity of the core B′ increased, and the armature C will be attracted by the core B′, and the spring *d* will be thrown and kept out of contact with its screw *c*, as long as the current operated with continues to be of the same polarity.

The polarized switch-magnet connects, by a wire, 10, with two keys, K K′, one of which will throw upon the line a positive and the other a negative current from the battery. The wire 10 is secured in the post *e* from which a wire, 11, extends to one end of the helix of the electro-magnet B B′. The other end, 12, of this helix is connected with and continues the circuit through the vibrating armature.

The posts *b b′*, which carry the adjusting-screws *c c′*, connect, by wires 13 and 14, with posts *f f′*, and from these posts extend the branch wires 15 and 16, which unite into one wire, 17, that leads back to the battery.

Instead of only two branches, 13 and 14, of the line 17, the currents at the points *c c'*, respectively, may be divided into a number of branches by arranging the contact-points and springs therefor.

Suppose the armature C so placed that the springs *d d'* will rest against both the points *c c'*, then a positive current (represented by full-line-arrows) from the battery will pass through the wires 10 and 11 to the electro-magnet B B'; thence through the wire 12 and the armature C, posts *b b'*, wires 13, 14, 15, 16, and 17 back to the battery. The armature will immediately be attracted by the core B', the contact between the spring *d* and screw *c* will be broken, and the whole current passes from the armature through wires 14, 16, and 17 back to the battery. The branch wire 15 is thus entirely switched out of the circuit. In actual working under battery the armature C will always rest and remain against the pole to which it is last attracted till the current is reversed, when it will instantly pass to the opposite pole. The design of the springs *d d'* is to preserve the continuity of the circuit in the transition of the armature C from one pole to the other of the switch-magnet B B' on reversal of the circuit. In such transition, as the double contact is only momentary, no effect will follow from it in the branch being switched out.

By depressing the key K' the armature is attracted by the core B, the current (represented by the dotted arrows) is made to pass through the wires 13, 15, and 17, and the branch wire 16 is switched out of the circuit.

I distinctly disclaim in this present application for a patent everything shown and described in my Patent No. 91,527; but I will here remark that by my new arrangement I am enabled to cut either of the branch wires entirely out of the circuit, so that the current passes with undivided and undiminished force through the other branch wire or wires.

In the former case the current is taken from either magnet by a simple cut-off or shortened circuit. The magnet is left inactive by virtue of presenting greater resistance than the cut-off; but there is more or less flow of current-power through the continuous circuit of the magnet thus cut out.

In the present case the effect is produced, not by a cut-off, but by an absolute break of that branch of the circuit to be left out. The current is automatically absolutely switched from one branch or set of branches to another by simply reversing the poles of the battery. Besides, if, in the former case, the tongue or armature should strike between the points out of contact with either, the magnets, all being in the same circuit, would all act simultaneously. If the spring *d d'* be held in connection with both points *c c'*, the current of the line would divide between the branches and their magnets. In the former case, if both switch-points were connected at the same time, all the magnets would be entirely cut out.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. An electro-mechanical switch, constructed substantially as described, in combination with two or more electro-magnets, placed in two or more distinct branches, 15 and 16, of the circuit containing said switch, all connected and operated substantially as described.

2. The springs *d d'*, in combination with the vibrating armature and the points *c c'*, for maintaining the continuity of the same circuit, substantially as set forth.

THOMAS A. EDISON.

Witnesses:

W. HAUFF,

E. F. KASTENHUBER.

2 Sheets—Sheet 1.

T. A. EDISON.

Printing Telegraph.

No. 96,567. Patented Nov. 9 1869.

Fig: 1.

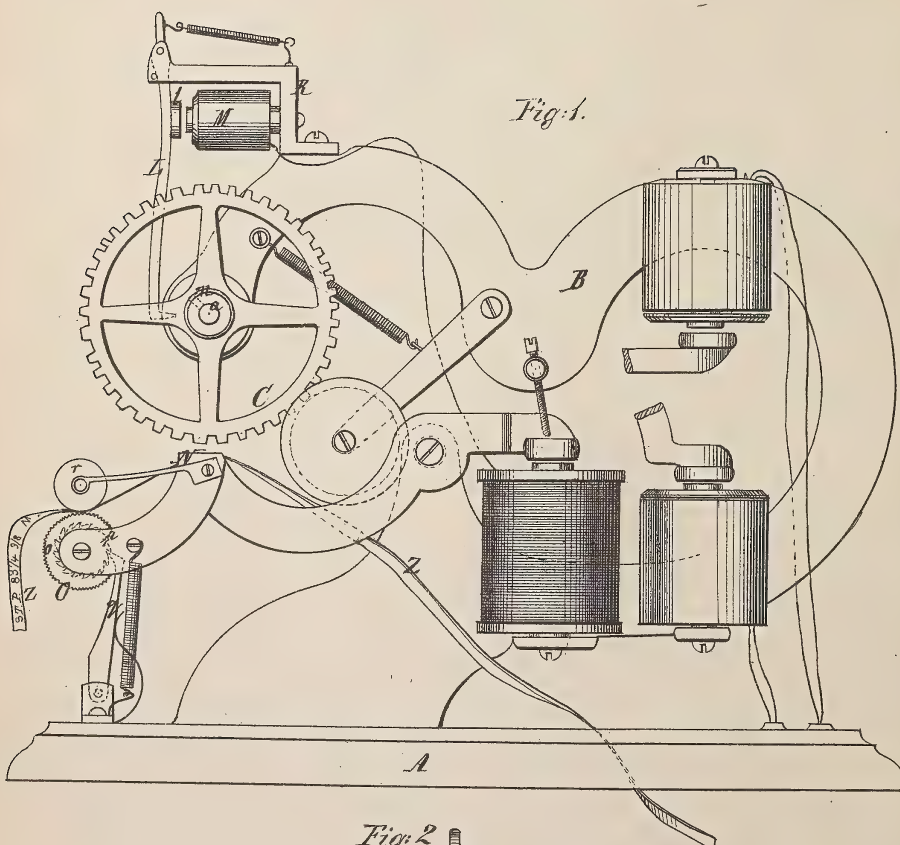
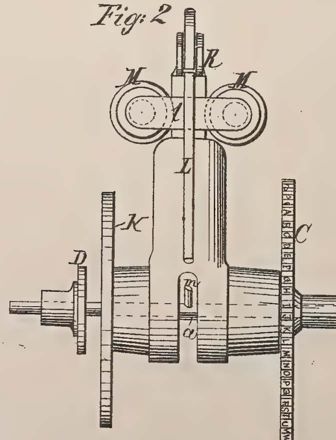


Fig: 2



Witnesses.

W. Hauff,

R Langmeister

Inventor.

Thomas. A. Edison

2 Sheets—Sheet 2.

T. A. EDISON.

Printing Telegraph.

No. 96,567. Patented Nov. 9 1869.

Fig: 3.

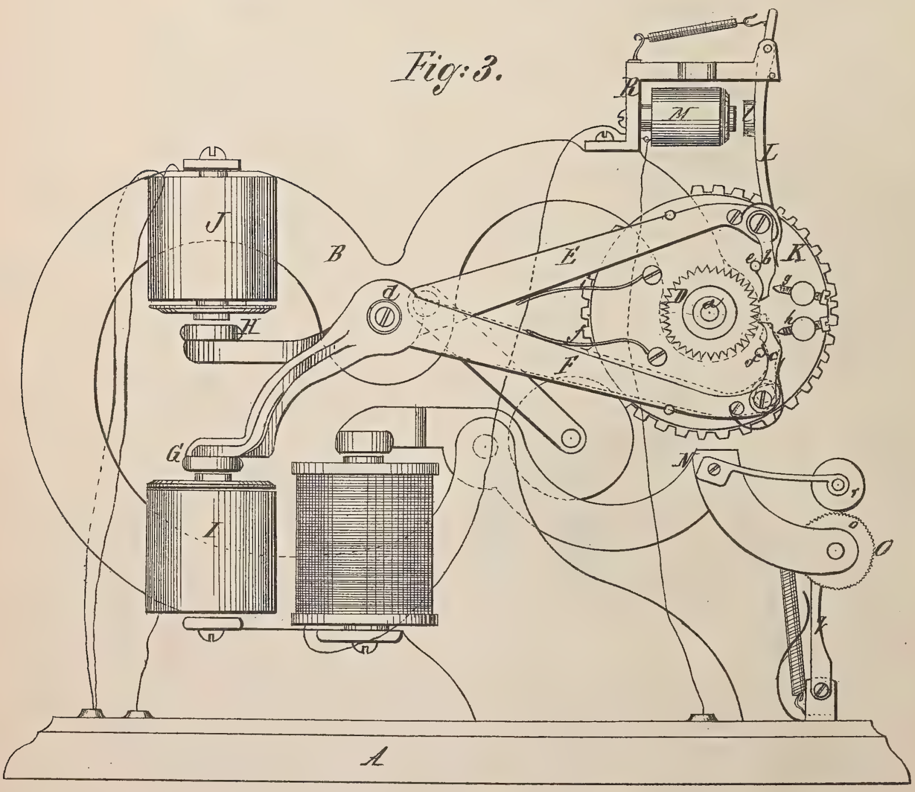


Fig: 4.

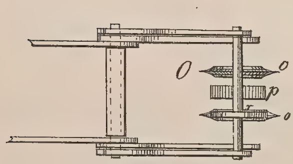
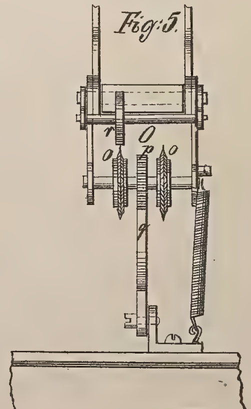


Fig: 5.



Witnesses.

W. Hauff,

R. Laugmeister

Inventor.

Thomas A. Edison

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEW YORK, N. Y., ASSIGNOR TO SAMUEL S. LAWS, OF SAME PLACE.

IMPROVEMENT IN PRINTING-TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **96,567**, dated November 9, 1869.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of the city, county, and State of New York, have invented a new and useful Improvement in Electrical Printing-Instruments; and do hereby declare the following to be a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing forming part of this specification, in which drawing—

Figure 1 represents a side elevation of this invention, showing the printing mechanism. Fig. 2 is a front view of the unison mechanism detached. Fig. 3 is a side elevation of my instrument, showing the mechanism for imparting to the type-wheel a step-by-step movement in either direction. Fig. 4 is a plan of the paper-feed mechanism detached. Fig. 5 is a front view of the same.

Similar letters indicate corresponding parts.

This invention relates to certain improvements in that class of instruments for which Letters Patent were granted to S. S. Laws December 31, 1867, and March 24, 1868, and also described in an application for a patent filed by said S. S. Laws in the Patent Office, January 4, 1869.

My present improvements consist in the arrangement of two dogs, pawls, or clicks, pivoted to two armature-levers, and acting on a star-shaped or double ratchet-wheel, in combination with stationary pins, which are not connected with the ratchet or pawls, and which act on the pawls in such a manner that by one set of pins the pawls are thrown out of gear with the ratchet, and by the other set of pins said pawls are locked in gear with the ratchet, and that by the action of the two pawls a uniform step-by-step movement can be imparted to the ratchet in either direction with ease and facility, the mechanism required for this purpose being exceedingly simple, and not liable to get out of repair, and the type-wheel or ratchet is held in position, when at rest, by means of a graduated or adjustable friction, instead of holding-pawls. The invention consists also in the arrangement of a separate magnet, in combination with the unison-lever, in such a manner that the operator has absolute control over the unison-stops of all the instruments in the line without danger of disturbing the power of any of the other magnets.

In the drawings, the letter A designates a bed-plate, from which rises an arm, B, which may be cast solid with, or otherwise rigidly attached to, said bed-plate. The outer end of this arm B is bored out to form a bearing for a shaft, *a*, on one end of which is mounted the type-wheel C, while on its other end is mounted the ratchet-wheel D, said shaft being fitted in its bearings so that it turns freely therein; but sufficient friction is secured by adjusting the position of the type-wheel to retain it in any position into which it may be brought. This friction may be obtained and regulated by the pressure of an adjustable spring upon the ratchet-shaft, or some part carried around thereby. The ratchet-wheel D is star-shaped or double acting, and it is acted upon by two pawls or clicks, *b c*, which are pivoted to levers E F, extending from the armatures G H of two electro-magnets, I J. Said levers have a common fulcrum on the pivot or stud *d*, which is rigidly secured in the arm B, and their armatures and electro-magnets are arranged in such relation to said levers and to the ratchet-wheel that, by alternately closing and opening the circuits through said electro-magnets, the levers E F are caused to oscillate in opposite directions, and that, by the action of one of the clicks, the ratchet-wheel assumes a step-by-step movement in one direction, while the other click produces a step-by-step movement of the ratchet-wheel in the opposite direction. The position of the clicks in relation to the teeth of the ratchet-wheel is governed by two sets of pins, *e f*, *g h*, which are secured in a disk, K, that is rigidly attached to the end of the arm B. The pins *e* and *f* act on projections on the inner edges of the clicks *b* and *c*, and if the levers E and F are forced back by the action of their springs *i* and *j*, said pins lift and hold the points of the clicks out of the path of the ratchet-teeth; and if either of the armatures is attracted, and its lever caused to move, the pawls, being released of the pins *e* and *f*, are thrown in gear with the ratchet-teeth by the action of their springs, and the stop-pin *g* or *h* acts against the outside edge of the corresponding click, and holds it in gear, and locks it with the ratchet-wheel, causing the

same to stop at the distance of one tooth. The stop-pins g and h might be combined into one pin, serving the same purpose for each of the pawls. By this arrangement a step-by-step movement can be imparted to the ratchet-wheel, governed by the action of the stationary pins $e\ f\ g\ h$ on the projections on the edges of said clicks, the friction of the type-wheel arbor being made sufficient to prevent the ratchet from moving when the lever-pawls are drawn back from the teeth.

It is obvious that the effect of the two clicks will be the same, if they are made to engage with two ratchet-wheels on the same arbor with teeth facing in opposite directions, such ratchets being a mechanical equivalent of the star-shaped ratchet shown in the drawing. The electro-magnets I and J are fastened to the arm B, so that they straddle said arm, and easy access can be had to them and to their connections.

In order to throw all the instruments on a line in unison, a "unison-lever," L, is used, such as described in the application of S. S. Laws for a patent on printing-telegraph, filed in the Patent Office January 4, 1869. This unison-lever is hinged to a bracket, R, which is firmly secured to the main arm B, and to said lever is attached the armature l of a separate electro-magnet, M, which is secured to the bracket R. The lower end of the unison-lever L forms a hook, (see Fig. 1,) and if the circuit through the electro-magnet M is closed, this hook is thrown in the path of a pin, m, which projects from the shaft a, (see Figs. 1 and 2,) so that the motion of said shaft is stopped as soon as the pin m comes in contact with the unison-lever. The pins m on the several instruments in a line are made to correspond in position to a certain type or character on the several type-wheels; and, consequently, by working all the instruments round in either direction, until the several pins m are brought in contact with the several unison-levers, all the type-wheels are arrested in the same position, and all the instruments are thrown into unison.

The object of working the unison-lever by a separate magnet is to enable the operator to control the position of said unison-lever without disturbing any other part of the mechanism, and particularly without diminishing the power of the main magnets, as when the unison-lever is operated by secondary armatures from either or both of the main magnets.

The strip of paper Z is carried through between the platen N and the type-wheel by the feed mechanism O. A roller, r, presses the strip of paper against one of the serrated rims or flanges o of the feed-wheel, and, as the platen-lever oscillates by the combined action of its electro-magnet and its detaching-spring, the ratchet of the feed-drum acts against the click q and receives an intermittent rotary motion, so that for each oscillation of the platen-lever the strip of paper is moved a sufficient distance to make room for a subsequent impression. The pressing-roller r is situated on the inside of the feed-drum, and consequently the letters and characters printed on the strip of paper are not at all concealed by it, while the strip passes through the feed mechanism, and said characters remain open to view from the time when they have been printed.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The stationary pins $e\ f\ g\ h$, in combination with the clicks $b\ c$, actuated by the armature-levers E F, and acting on the ratchet D, substantially as and for the purpose described.

2. The combination of a separate electro-magnet with the unison-lever L, substantially as set forth.

Witnesses: THOMAS A. EDISON.

W. HAUFF,

E. F. KASTENHUBER.

2 Sheets—Sheet 1.

T. A. EDISON.

Printing Telegraph.

No. 3,820. Reissued Feb. 1, 1870.

Fig: 1.

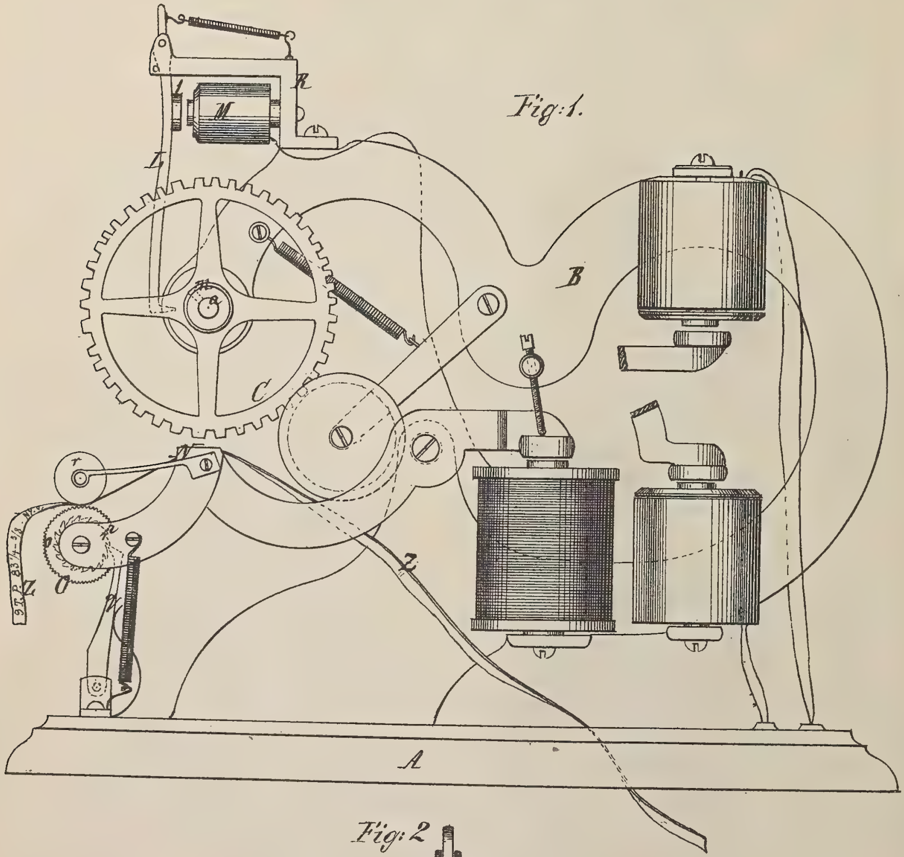
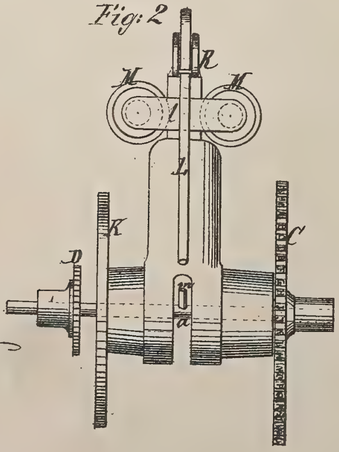


Fig: 2



Witnesses.

W. Hauff

R. Langmeister

Inventor.

Thomas A. Edison

N. PETERS, Photo-Lithographer, Washington, D. C.

2 Sheets—Sheet 2.

T. A. EDISON.

Printing Telegraph.

No. 3,820. Reissued Feb. 1, 1870.

Fig: 3.

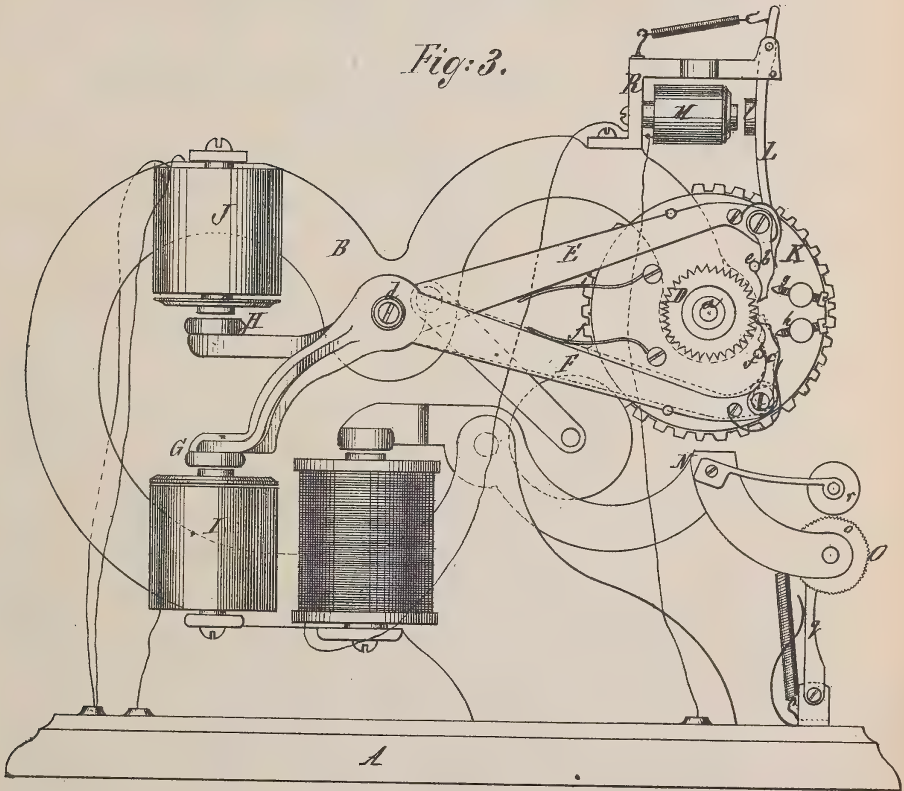


Fig: 4.

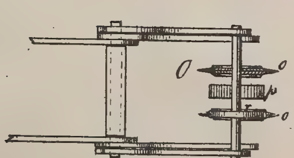
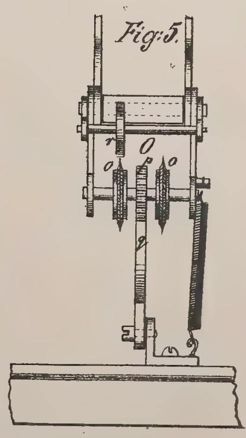


Fig: 5.



Witnesses.
W. Hauff,
R. Langmeister

Inventor.
Thomas A. Edison

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE

THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y., ASSIGNEES, BY MESNE ASSIGNMENTS, OF THOMAS A. EDISON.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 96,567, dated November 9, 1869; reissue No. **3,820**, dated February 1, 1870.

To all whom it may concern:

Be it known that THOMAS A. EDISON, of the city, county, and State of New York, did invent a new and useful Improvement in Electrical Printing-Instruments; and the following is hereby declared to be a full, clear, and exact description thereof.

Figure 1 represents a side elevation of this instrument, showing the printing mechanism. Fig. 2 is a front view of the unison mechanism detached. Fig. 3 is a side elevation of my instrument, showing the mechanism for imparting to the type-wheel a step-by-step movement in either direction. Fig. 4 is a plan of the paper-feed mechanism detached. Fig. 5 is a front view of the same.

This invention relates to certain improvements in that class of instruments for which Letters Patent were granted to S. S. Laws December 31, 1867, and March 24, 1868; and also described in an application for a patent filed by said S. S. Laws in the Patent Office January 4, 1869. Before this invention, a type-wheel had been moved in either direction with a step-by-step motion, and a pawl or click had been used in other machinery to run beneath a stop and block the further movement of the ratchet-wheel.

In printing-telegraphs, it is necessary to stop the character-wheel with great accuracy, so that the impression may be properly made. To effect this object, the stop that acts to block the pawl or click and type-wheel is adjustable, so as to compensate wear or inaccuracy of workmanship; and by making clicks to act in opposite directions, by levers and electro-magnets, the type-wheel can be moved progressively in either direction, and stopped accurately, the clicks and stops limiting the movement of the lever, armature, ratchet-wheel, and character-wheel.

The invention consists in the arrangement of a separate magnet in combination with the unison-lever, in such a manner that the operator has absolute control over the unison-stops of all the instruments in the line without danger of disturbing the power of any of the other magnets.

In the drawings, A designates a bed-plate, from which rises an arm, B, which may be cast solid with, or otherwise rigidly attached to, said bed-plate. At the outer end of this arm B is a bearing for the shaft *a*, on one end of which is mounted the type-wheel C, while near its other end is the ratchet-wheel D, said shaft being fitted in its bearings so that it turns freely, but sufficient friction is provided to steady the type-wheel in any position into which it may be brought. This friction may be obtained and regulated by the pressure of an adjustable spring upon the ratchet-shaft, or otherwise. The ratchet-wheel D is star-shaped or double-acting, and it is acted upon by two pawls or clicks, *b c*, which are pivoted to levers E F extending from the armatures G H of two electro-magnets, I J. Said levers may have a common fulcrum on the pivot or stud *d*, and their armatures and electro-magnets are arranged in such relation to said levers, and to the ratchet-wheel D, that the levers E F are caused to oscillate in opposite directions when their respective magnets are charged; and, by the action of one of the clicks, the ratchet-wheel assumes a step-by-step movement in one direction, while the other click produces a step-by-step movement of the ratchet-wheel in the opposite direction. The position of the clicks in relation to the teeth of the ratchet-wheel is governed by two sets of stops, *e f g h*, which are secured in a disk, K, at the end of the arm B or other rigid support. The stops *e* and *f* act on projections on the inner edges of the clicks *b c*, respectively; and when the levers E and F are forced back by the action of their springs *i* and *j*, said pins lift and hold the points of the clicks out of the path of the ratchet-teeth; and if either of the armatures is attracted, and its lever caused to move, the pawl, being released of the pin *e* or *f*, is thrown in gear with the ratchet-teeth by the action of its spring, and the stop-pin *g* or *h* acts against the outside edge of the click, and holds it in gear and locks it with the ratchet-wheel, causing the same to stop at the distance of one tooth; and this is effected with accuracy by adjusting the stop *g* or *h*. The stop *g* or *h* might be combined into one pin, serving the same purpose for each of the pawls. By this arrangement, a step-by-step movement can be imparted to

the ratchet-wheel, and it is governed by the action of the stops *e f g h* on the clicks, the friction applied to the type-wheel or arbor being sufficient to prevent the ratchet from moving when the lever-pawls are drawn back from the teeth.

It is obvious that the effect of the two clicks will be the same if they are made to engage with two ratchet-wheels on the same arbor, with the teeth facing in opposite directions, such ratchets being a mechanical equivalent of the star-shaped ratchet shown in the drawing, and each ratchet-wheel, click, and adjustable stop acting in the manner aforesaid.

The pairs of electro-magnets I J may be fastened to the arm B, so that said arm comes between them, and easy access can be had to them and to their connections.

In order to throw all the instruments on a line in unison, a unison-lever, L, is used, substantially such as described in the application of S. S. Laws for a patent on printing-telegraph, filed in the Patent Office January 4, 1869. This unison-lever is hinged to a bracket, R, which is firmly secured to the main arm B, and to said lever is attached the armature *l* of a separate electro-magnet, M. The lower end of the unison-lever L forms a hook, (see Fig. 1;) and if the circuit through the electro-magnet M is closed, this hook is thrown in the path of a pin, *m*, which projects from the shaft *a*, (see Figs. 1 and 2,) so that the motion of said shaft is stopped as soon as the pin *m* comes in contact with the unison-lever. The pins *m* on the several instruments in a line are made to correspond in position to a certain type or character on the several type-wheels, and, consequently, by working all the instruments round in either direction until the several pins *m* are brought in contact with the several unison-levers, all the type-wheels are arrested in the same position, and all the instruments are thrown into unison. The object of working the unison-lever by a separate magnet is to enable the operator to control the position of said unison-lever without disturbing any other part of the mechanism, and particularly without diminishing the power of the main magnets, as when the unison-lever is operated by secondary armatures from either or both of the main magnets. The strip of paper Z is carried through between the platen N and the type-wheel by the feed mechanism O. A roller, *r*, presses the strip of paper against one of the serrated rims or flanges *o* of the feed-wheel, and as the platen-lever oscillates, by the combined action of its electro-magnet and its detaching-spring, the ratchet of the feed-drum acts against the click *q*, and receives an intermittent rotary motion, so that for each oscillation of the platen-lever the strip of paper is moved a sufficient distance to make room for a subsequent impression. The pressing-roller *r* is situated on the inside of the feed-drum, and consequently the letters and characters printed on the strip of paper are not at all concealed by it, and said characters remain open to view from the time when they are printed.

What is claimed as the invention of Thomas A. Edison is—

1. The adjustable stop *g* or *h*, in combination with the click *b* or *c* and ratchet-wheel D, substantially as specified, whereby the position of the wheel D, when blocked and stopped, can be adjusted by the stop *g* or *h*, substantially as set forth.

2. The adjustable stop *g* or *h*, click *b* or *c*, ratchet-wheel D, and lever E or F, in combination with the type or character wheel C and an electro-magnet to give motion to the lever, substantially as and for the purposes set forth.

3. The clicks *b c*, levers E F, magnets I J, and ratchet-wheel D, in combination with the stops *e g f h*, substantially as specified, for moving a type or character wheel with a step-by-step motion in either direction, substantially as specified.

4. The unison-lever L, in combination with the type or character wheel and a separate electro-magnet, M, substantially as specified.

Dated December 28, A. D. 1869.

GEO. B. FIELD, *President*,
H. S. HOTCHKISS, *Secretary*,
The Gold and Stock Telegraph Company.

Witnesses:
Chas. H. Smith,
Geo. D. Walker.

POPE & EDISON.

Printing Telegraph.

No. 102,320. Patented April 26, 1870.

Fig. 1.

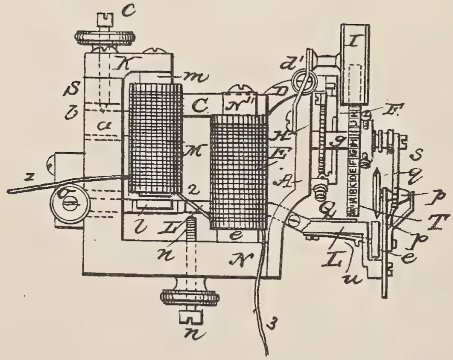


Fig. 2.

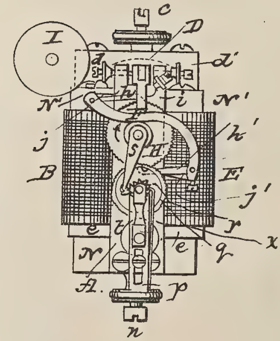


Fig. 5

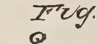


Fig. 3

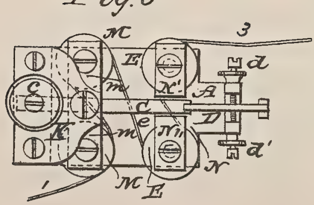


Fig. 4

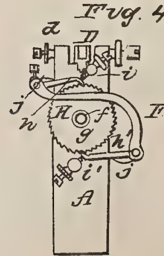
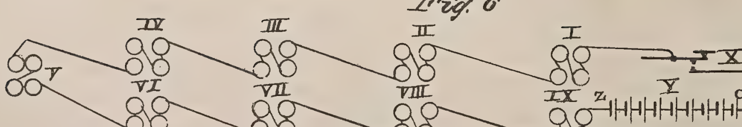


Fig. 6



Witnesses

M. M. Livingston

T. L. Beecher

Inventor

Frank L. Pope

Thomas A. Edison

UNITED STATES PATENT OFFICE.

FRANK L. POPE, OF ELIZABETH, NEW JERSEY, AND THOMAS A. EDISON, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **102,320**, dated April 26, 1870.

To all whom it may concern:

Be it known that we, FRANK L. POPE, of Elizabeth, in the county of Union and State of New Jersey, and THOMAS A. EDISON, of the city, county, and State of New York, have invented certain new and useful Improvements in Printing-Telegraphs; and we hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, which forms part of this specification.

The nature of this invention consists in so arranging the parts of a telegraphic printing apparatus that the same is not only capable of receiving and recording communications in automatically-printed characters at a much greater speed than has been found practicable by the instruments in common use, but the same result is accomplished by the use of one wire without local batteries, which has heretofore required the use of two or more wires, or a local battery, or both, in connection with each instrument.

In the accompanying drawings, Figure 1 is a side elevation of the receiving apparatus. Fig. 2 is an end elevation of the same, the type-wheel being removed. Fig. 3 is a plan view of a portion of said apparatus. Fig. 4 is a detached view, showing the details of the escapement in said apparatus. Fig. 5 is a plan view of the slotted presser; and Fig. 6 is a skeleton diagram, showing the arrangement of a number of instruments located at different stations, and placed in the same electrical circuit, operated simultaneously in unison by a battery placed at one point in the circuit.

Similar letters refer to like parts in the different figures.

E, Figs. 1, 2, and 3, designates a perpendicular electro-magnet, composed of two cores of soft iron united below in the ordinary manner by a cross-bar, *e*, also of soft iron. The north pole of an angular bent permanent magnet, N S, is screwed to the cross-bar *e*, to which it communicates north polarity beyond the point of contact, and also to both the cores and poles of the electro-magnet E. The soft-iron tongue C is supported upon a pivot, *a*, in a slot, *b*, in the south end S of the permanent magnet N S, being secured in position by a screw, *c*, or otherwise, from which it receives south polarity. The tongue C is so placed that it may vibrate in a lateral direction between the north poles N′ and N″ of the electro-magnet E. It will therefore be seen that the north polarized ends N′ and N″ will each exert an equal attraction upon the south polarized tongue C when the same is equidistant from each, and that the same will be attracted and firmly held by either N′ or N″ when placed in close proximity or contact with one or the other. An arm, D, projects from the end of the tongue C, passing between screw-stops *d* and *d′*, by means of which screw-stops its lateral vibration is controlled and limited. The arm D is constructed of brass or other non-magnetic metal, in order to prevent the inductive magnetic action from extending beyond the poles N′ N″ of the electro-magnet E. The screw-stops *d* and *d′* are supported by a brass standard, A. Upon this standard is secured a shaft, *f*, Fig. 4, upon which is arranged a sleeve, *g*, carrying a ratchet-wheel, H, and a type-wheel, T, upon the circumference of which type-wheel are engraved such letters, numerals, or other characters as may be required. The characters on the type-wheel are supplied with ink by means of a fountain ink-roller, I, secured to a movable arm attached to the standard A. The vibrating arm D carries a curved bar, F, to the extremities of which are pivoted pawls *h* and *h′*, which act, respectively, at opposite points upon the circumference of the ratchet-wheel H, as shown in Figs 2 and 4. The movement of said pawls, and consequently that of the wheel H, is limited by the adjustable screw-stops *i i′*, by the end of the said pawls falling in the spaces of the wheel H and its upper beveled edge subsequently coming in contact with the stop *i* or *i′*, which may be adjusted so as to allow of any desired amount of movement of the said pawls *h* and *h′*, and the pawls are kept in contact with the teeth of the ratchet-wheel by springs *j j′*; but we will here remark that the pawls *h* and *h′* may be made of spring steel, and so arranged as to automatically bear in the interdental spaces of the wheel I, in which case the springs *j j′* may of course be dispensed with. By means of the above-described arrangement, the vibrations of the arm D may be caused to communicate

through the pawls a rapid intermittent rotary motion to the ratchet-wheel H, sleeve g, and type-wheel T in the direction shown by the arrow marked thereon. The screw-stops d d' are so adjusted in reference to the stops i i', that when the tongue C is actuated by a powerful current tending to bend or otherwise disarrange the pawls h h', ratchet-wheel H, and their appurtenances, the slightest deflection of the arm D, after the pawls h or h' have come in contact with the stops i or i', will bring said arm D against one of the stops d or d', thereby relieving said pawls, ratchet-wheel, &c., from undue strain or pressure. The manner in which the vibration of the tongue C and arm D is made to revolve the ratchet-wheel H will be understood more clearly by reference to Fig. 4. Suppose the arm d to be moved from its position, as shown, toward the left, carrying with it the bar F and the pawls h h'. The pawl h' will engage with a tooth of the wheel H, and carry it forward in the direction of the arrow until its movement is arrested by the pawl coming in contact with the stop i'. At the same time the pawl h will slip over one tooth of the wheel without obstruction. When the arm D, bar F, and pawls h h', are moved from left to right, the operation of the respective pawls is reversed, although the wheel H continues to be moved in the same direction as before. Each vibration of the arm D, either to the left or to the right, therefore advances the ratchet-wheel H the distance of one tooth. The apparatus for taking the impression after the type-wheel has been brought to the desired position, may be described as follows: M, Figs. 1 and 3, is an electro-magnet of the usual form, its poles being united by the cross-bar m, which is secured to a lug, K. This lug is firmly secured to the south end S of the permanent magnet N S. This lug is made of brass, or any other non-magnetic metal, for the purpose of cutting off the magnetic induction which would otherwise take place between the permanent magnet N S and the soft-iron cores of the electro-magnet M. The armature l of said electro-magnet is attached to a lever, L, one end of which is pivoted at O, and which passes through a slot in the standard A. The lever L is capable of a vertical movement upon O as its fulcrum, the extent of such movement being limited in one direction by the face of the type-wheel T, and in the other by the adjustable screw-stop n. To the extremity of the lever L is attached a slotted adjustable standard, p, carrying a wheel, q, with a sharp serrated edge. Upon the same shaft with said wheel q is a ratchet-wheel, r, actuated by a hook-shaped pawl, s, attached to the extremity of the type-wheel shaft f. A roller, t, of hard rubber, or other suitable material, is mounted upon a spring-axle, u, in such a manner as to be pressed firmly against the serrated edge of the wheel q. A ribbon of paper (not shown in the drawing) may be made to pass horizontally across the lever L, and beneath the slotted presser Q, shown in plan in Fig. 5, the edge of said paper passing between the serrated wheel q and the roller t in such a manner that the rotation of the wheel q will cause the ribbon to be drawn forward from right to left. The slotted presser Q serves to keep the paper from coming in contact with any portion of the type-wheel, except the letter of which the impression is desired. The two electro-magnets E and M are placed in the same electrical circuit, the connections being arranged as shown in Fig. 3.

The manner in which the above-described apparatus is actuated by means of electric currents is as follows: If a momentary current of electricity be sent from the positive pole of a battery through the electro-magnets E and M, its tendency would be to magnetize the pole N′ of the electro-magnet E "north," and the pole N″ "south;" but as both poles were previously north by the inductive influence of the permanent magnet N S, the effect of this current is to strengthen the north magnetism of N′, and to weaken or entirely destroy that of N″. The tongue C is therefore attracted to N′ with double force, and remains on that side after the cessation of the current, being still attracted by the pole N′, whose distance from C is now much less than that of N″. If, now, a momentary negative current is sent, this effect is reversed. The pole N″ in turn attracts the tongue, and it moves to that side, remaining until the polarity of the exciting current is again changed. Thus, by transmitting through the helices of the electro-magnet E a rapidly-alternating series of positive and negative currents, it will readily be seen that the tongue C, the arm D, and its attachments may be caused to vibrate to and fro with great rapidity, causing a correspondingly rapid revolution of the ratchet-wheel H and type-wheel T. It will be seen, therefore, that the type-wheel T may readily be brought to any required position simply by transmitting the requisite number of alternate positive and negative currents through the electro-magnet E. When the type-wheel T is thus brought to its proper position, the impression of the required letter is taken from the wheel, as follows:

The electro-magnet M, as heretofore explained, is in the same electrical circuit with E. In operating said electro-magnet advantage is taken of the fact that currents of such short duration as not to sensibly affect an electro-magnet of the ordinary construction will operate perfectly a polarized or combination magnet composed of permanent and electro-magnets placed in conjunction; and also that the attractive force of an ordinary electro-magnet is the same, whatever may be the polarity of the exciting current. Therefore, a succession of positive and negative currents may be sent through the wire 1 2 3, Figs. 1 and 3, of such short duration as not to affect in any manner the electro-magnet M, while by the action of the polarized electro-magnet E the type-wheel T may be revolved until the

desired letter upon its circumference is brought opposite the impression-lever L. The duration of the final current is then prolonged, regardless of its polarity, until the electro-magnet M has time to act, when its attraction raises the lever L and brings the paper ribbon in contact with the type upon the wheel T, the same having been previously inked by the fountain-roller I. When the attraction of the electro-magnet M ceases, the lever L returns to its original position. At the same time the hooked pawl *s* catches a tooth of the ratchet-wheel *r* and causes it, together with the wheel *q*, to revolve a short distance, thus drawing the paper ribbon forward, and leaving a clear space in readiness for the next impression. A click, *x*, prevents the ratchet-wheel *r*, and consequently the wheel *q*, from revolving in the opposite direction. The downward movement of the lever L may be assisted by a retracting-spring, if necessary.

It will be seen from the above description that this apparatus is actuated entirely by electro-magnetic power derived from the battery at the transmitting-station, without the assistance of local or secondary batteries, or of mechanical power derived from any source other than the said battery at the said transmitting-station, and that any required number of such apparatus may be placed at various points included in the same electric circuit, and operated simultaneously in unison by the action of a single battery placed at the transmitting-station. This will be more clearly understood by reference to Fig. 6, where we have given a skeleton diagram, illustrating an arrangement of instruments in connection with a main battery and circuit-breaker, whereby an operator can at one point form a connection with a main battery, so as to complete an electric circuit in such manner that the current of said battery shall pass through as many instruments on a main line unprovided with local batteries as desired, and record simultaneously in printed characters at each instrument the same message. For instance, at a point lettered X there may be located a circuit-breaker of any suitable construction, and at the point lettered Y a main battery of sufficient power, or in lieu thereof a number of small main batteries, located at such point or elsewhere in the main circuit, that a current may be caused to pass from the main battery or batteries through the electro-magnets of instruments I, II, III, &c. Hence it will be understood without further explanation that a communication may be printed simultaneously at as many different stations as may be desired without the use of local batteries, or of mechanism, such, for instance, as weights or springs, for operating each instrument. In such cases the action of such local batteries or mechanism is simply controlled by the action of the main electrical circuit. It is obvious that another electro-magnet can be placed in the same circuit for effecting other useful purposes, such as striking a bell to call attention, &c., which may be actuated by increasing the strength of the electric current which operates the printing mechanism. It is also obvious that a local battery may be employed to bring into action a magnet not in the same circuit by insulating one of the stops *d d'* upon the standard A, and connecting it with the local circuit in such manner that the rapid vibrations of the arm D will not allow it to remain in contact with the stop long enough to permit the local or secondary battery to charge its electro-magnet; but when the vibrations are made to cease by the action of the transmitting-operator, or otherwise, the arm D will remain in contact with the stop *d'* a sufficient time to allow the secondary electro-magnet to become changed.

We do not confine ourselves to the particular form and arrangement of parts shown in the drawing. There are numerous and well-known means of producing the vibratory movement of a lever by the use of alternate positive and negative currents, in combination with a permanent and an electro magnet acting upon each other, and of applying the same to the movement of a type-wheel. Neither do we wish to confine ourselves to any particular method of producing or transmitting alternate positive and negative currents for the purpose specified.

We have shown in Fig. 6 the main line passing through both magnets of each instrument, this being the simplest and most convenient way of operating; but it is obvious that two main lines or wires may be employed, one running through one magnet of each instrument and the other through the other magnet of each instrument. In this latter case one line or wire is worked to revolve the type-wheel in proper position, and the other to cause the impression.

We are aware that it is not new to construct and operate one or more automatic printing-telegraph instruments in one or more circuits which derive all their motive power from electro-magnets, or to operate such instruments by the use of a single battery placed at some convenient point, in conjunction with mechanical power applied to each instrument separately. We are also aware that automatic printing-telegraph instruments have been operated by means of two or more distinct main circuits, in which case the impression or printing magnet of each instrument is placed in one of the said circuits, and one or more magnets for operating the type-wheel of each instrument is placed in one or more additional main circuits, as shown and described in the patent granted to E. A. Calahan on the 21st of April, 1868.

We believe to be new the arrangement of a number of automatic telegraphic printing instruments of any suitable construction connected by a single electric circuit, all the parts of said instruments being actuated exclusively by electrical power derived from one or more main batteries placed in and forming part of such circuit, without the aid of local batteries.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The combination of a number of automatic printing-telegraph instruments arranged in one main circuit, and operating simultaneously in unison, when the electro motive-power used in operating the same is derived exclusively from one or more main batteries placed in such main circuit without the aid of secondary or local batteries, or of mechanism actuated by springs or otherwise, substantially in the manner and for the purpose set forth.

2. The combination of a polarized magnet with an electro-magnet placed in the same electrical circuit, and operated substantially as described, and for the purpose set forth.

3. The combination of the ratchet-wheel I, bar F, pawls *h h′*, stops *i i′*, and type-wheel T, arranged and operating substantially as and for the purposes herein specified.

4. The combination of an electro-magnet with the ratchet-wheel, bar, pawls, stops, and polarized magnet, substantially as and for the purposes herein specified.

5. The arrangement of the permanent magnet N S, polarized magnet E, electro-magnet M, tongue C, arm D, bar F, pawls *h h′*, stops *i i′*, springs *j j′*, ratchet-wheel H, type-wheel T, and standards A K, all constructed, arranged, and operating substantially as and for the purpose herein specified.

6. The roller *t*, serrated wheel *q*, pawl *s*, ratchet-wheel *r*, click *x*, and standard *p*, in combination with the polarized magnet E and the electro-magnet M, and their appurtenances, for the purpose set forth.

7. The screw-stops *d d′* upon the standard A, in combination with the type-wheel T, substantially as herein specified.

8. The arrangement of the tongue C in the slot *b* of the permanent magnet N S by means of a pivot, *a*, and screw *c*, whereby the inductive magnetic influence of the permanent magnet N S upon the tongue C is greatly increased, substantially as herein set forth.

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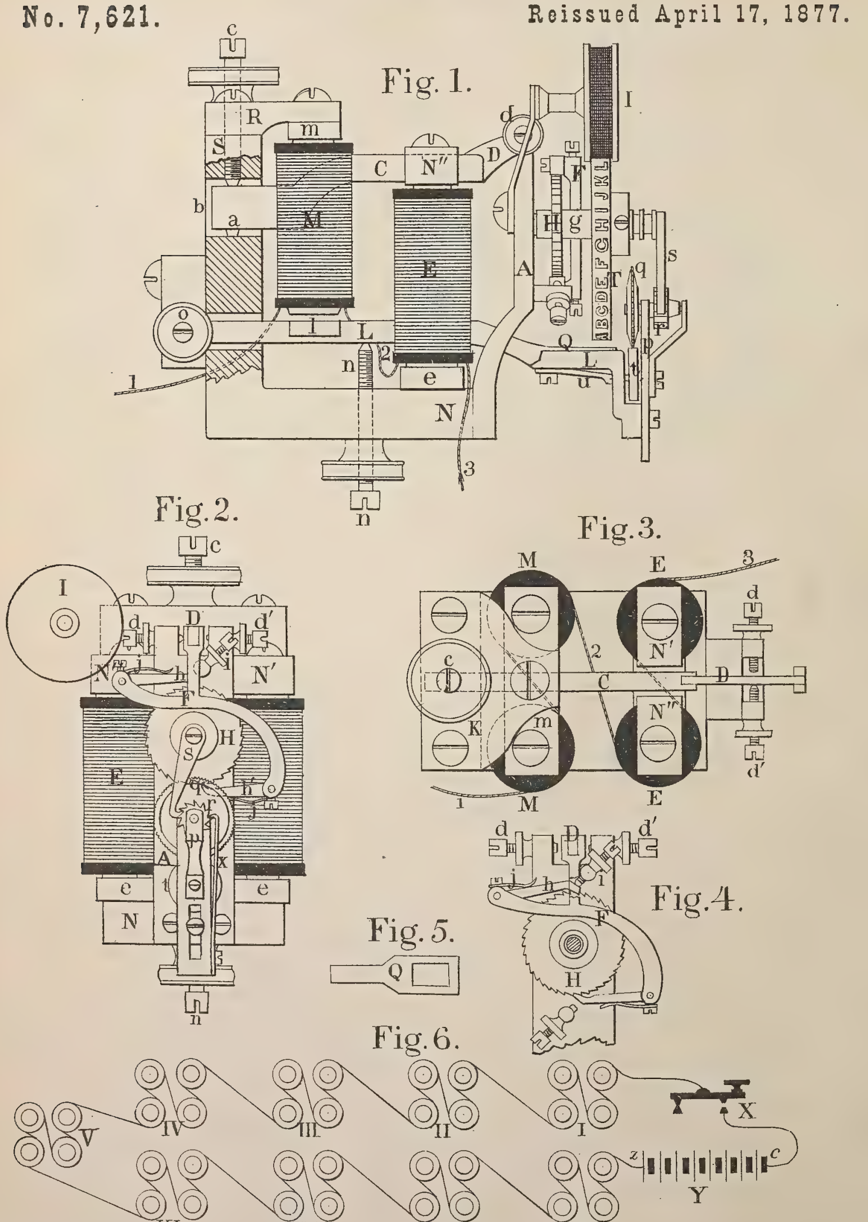
PRINTING TELEGRAPH.

No. 7,621. Reissued April 17, 1877.



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UNITED STATES PATENT OFFICE.

FRANK L. POPE, OF ELIZABETH, AND THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNORS, BY MESNE ASSIGNMENTS, TO THE GOLD AND STOCK TELEGRAPH COMPANY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 102,320, dated April 26, 1870; reissue No. **7,621**, dated April 17, 1877; application filed March 21, 1877.

To all whom it may concern:

Be it known that we, FRANK L. POPE, of Elizabeth, in the county of Union, and THOMAS A. EDISON, now of Menlo Park, in the county of Middlesex, both in the State of New Jersey, have invented certain new and useful Improvements in Printing-Telegraphs, which improvements are fully set forth in the following specification, reference being had to the accompanying drawings:

Our invention relates to that class of printing-telegraph instruments in which the type-wheel is caused to rotate by means of a step-by-step escapement actuated or controlled by the armature of an electro-magnet in the main circuit, and when any desired character upon the type-wheel has been brought round to a given point an impression of such character may be printed by bringing into action a second armature controlled by the same circuit.

Our improvements consist, first, in a method of imparting to the type-wheel an intermittent rotary motion by the action of successive alternate positive and negative currents of short duration, and of locking the type-wheel at any point, and at the same time printing a letter or character by prolonging the duration of the final current, whether the same is positive or negative; second, in the combination of a type-wheel, actuated or controlled by a polarized armature, under the influence of alternate reverse currents of short and uniform duration, with a device for giving the impression which is actuated or controlled by a non-polarized or neutral armature, the arrangement being such that the type-wheel may be locked, and the neutral armature brought into action to effect the printing when the type-wheel has been brought to the required point by prolonging the duration of the final current, without reference to its polarity; third, in certain improved combinations of the mechanism of the several parts of the apparatus, whereby the efficiency and reliability of its action are materially increased.

In the accompanying drawing, Figure 1 is a side elevation of the receiving apparatus. Fig. 2 is an end elevation of the same, the type-wheel being removed. Fig. 3 is a plan view of a portion of said apparatus. Fig. 4 is a detached view, showing the details of the escapement in said apparatus. Fig. 5 is a plan view of the slotted presser, and Fig. 6 is a skeleton diagram, showing the arrangement of a number of instruments located at different stations, and placed in the same electric circuit, operated simultaneously in unison by a battery placed at one point in the circuit.

Similar letters refer to like parts in the different figures.

E, Figs. 1, 2, and 3, designates a perpendicular electro-magnet, composed of two cores of soft iron, united below in the ordinary manner by a cross-bar, *e*, also of soft iron. The north pole of an angular permanent magnet, N S, is screwed to the cross-bar *e*, to which it communicates north polarity beyond the point of contact, and also to both cores and poles of the electro-magnet E. The soft-iron armature C is supported upon a pivot, *a*, in a slot, *b*, in the south end S of the permanent magnet N S, from which it receives south polarity, being secured in that position by a screw or otherwise. The said slot is situated at a short distance from the end of the magnet, exactly at the point of greatest magnetic intensity, so that the pivot end of the armature is completely surrounded by the magnetic mass, and becomes subject to the greatest possible amount of inductive influence.

The armature C is so placed that it is free to vibrate to and fro in a lateral direction between the poles N′ and N″ of the electro-magnet E. When this is arranged, it is obvious that the north polarized ends N′ and N″ will each exert an equal attraction upon the south polarized armature C when the same is equidistant from each, but that it will be attracted and firmly held by either N′ and N″ when placed in close proximity or contact with one or the other. An arm, D, projects from the end of the armature C, passing between screw-stops *d* and *d′*, by means of which its lateral vibration is controlled and limited. This arm is constructed of brass or other non-magnetic metal, in order to prevent the inductive magnetic action from extending beyond the poles N′ N″ of the electro-magnet E.

The screw-stops d and d' are supported by a standard, A. Upon this standard is secured a shaft, f, Fig. 4, upon which is a sleeve, g, carrying a ratchet-wheel, H, and a type-wheel, T, upon the circumference of which type-wheel are engraved such letters, numerals, or other characters as may be required. The characters on the type-wheel are supplied with ink by means of a fountain ink-roller, I, secured to a movable arm attached to the standard A. The vibrating arm D carries a curved bar, F, to the extremities of which are pivoted pawls h and h', which act respectively at opposite points upon the circumference of the ratchet-wheel H, as shown in Figs. 2 and 4.

The to-and-fro movement of the pawls, as well as each successive step in the forward movement of the wheel H, which is driven by them, is limited by the adjustable stops i and i'. The pawls are pressed against the teeth of the wheel by springs j j'; and when the arm D vibrates to and fro, the pawls alternately fall into the interdental spaces of the wheel H and push it forward until the movement of the pawl, and consequently that of the wheel, also, is arrested by the stop i or i', which may be adjusted so as to allow of any desired amount of movement of the pawls h and h'. But we will here remark that the pawls h and h' may be made of spring-steel, and so arranged as to automatically bear in the interdental spaces of the wheel H, in which case the springs j j' may, of course, be dispensed with.

By means of the above-described arrangement the to-and-fro vibrations of the arm D may be caused to communicate, through the pawls, a rapid intermittent rotary motion to the ratchet-wheel H, sleeve g, and type-wheel T in the direction shown by the arrow marked thereon. The screw-stops d d' are so adjusted in reference to the stops i i' that when the armature C is acted upon by a powerful current, tending to bend or otherwise disarrange the pawls h h', ratchet-wheel H, and their appurtenances, the slightest deflection of the arm D, after the pawls h or h' have come in contact with the stops i or i', will bring said arm D against one of the stops d or d', thereby relieving the mechanism from undue strain or pressure.

The manner in which the vibration of the armature C and arm D is made to revolve the ratchet-wheel H will be understood more clearly by reference to Fig. 4. Suppose the arm D to be moved from its position, as shown, toward the left, carrying with it the bar F and the pawls h h', the pawl h' will engage with a tooth of the wheel H, and carry it forward in the direction of the arrow until its movement is arrested by the pawl coming in contact with the stop i'; at the same time the pawl h will slip over one tooth of the wheel without obstruction. When the arm D, bar F, and pawls h h' are moved from left to right the operation of the respective pawls is reversed, although the wheel H continues to be moved in the same direction, as before. Each vibration of the arm D either to the left or to the right therefore advances the ratchet-wheel H the distance of one tooth.

The apparatus for taking the impression after the type-wheel has been brought to the desired position may be described as follows: M, Figs. 1 and 3, is an electro-magnet of the usual form, its poles being united by the cross-bar m, which is secured by a lug, K, to the south end S of the permanent magnet N S. This lug is made of non-magnetic metal, for the purpose of cutting off the magnetic induction which would otherwise take place between the permanent magnet N S and the soft-iron cores of the electro-magnet M.

The armature l of this electro magnet is of soft iron, and attached to a lever, L, one end of which is pivoted at O, and which passes through a slot in the standard A. The lever is capable of a vertical movement upon O as its fulcrum, the extent of such movement being limited in one direction by the face of the type-wheel T, and in the other by the adjustable screw-stop n.

To the extremity of the lever L is attached a slotted adjustable standard, R, carrying a wheel, q, with a sharp serrated edge. Upon the same shaft with said wheel q is a ratchet-wheel, r, actuated by a hook-shaped pawl, s, attached to the extremity of the shaft f. A roller, t, of hard rubber or other suitable material, is mounted upon a spring-axle, u, in such a manner as to be pressed firmly against the serrated edge of the wheel q. A ribbon of paper (not shown in the drawing) may be made to pass horizontally across the lever L and beneath the slotted presser Q, (shown in plan in Fig. 5,) the edge of said paper passing between the serrated wheel q and the roller t in such a manner that the rotation of the wheel q will cause the ribbon to be drawn forward from right to left. The slotted presser Q serves to keep the paper from coming in contact with any portion of the type-wheel, except the letter of which the impression is desired. The two electro-magnets E and M are placed in the same electrical circuit, the connections being arranged as shown in Fig. 3.

The manner in which the above-described apparatus is actuated by means of electric currents is as follows:

If a momentary current of electricity be sent from the positive pole of a battery through the electro-magnets E and M, its tendency would be to magnetize the pole N′ of the electro-magnet E "north" and the pole N″ "south," but as both poles were previously north by the inductive influence of the permanent magnet N S, the effect of this current is to strengthen the north magnetism of N′ and to weaken or entirely destroy that of N″. The armature C is therefore attracted to N′ with double force, and remains on that side after the cessation of the current, being still attracted by the pole F′, whose distance from C is now much less than that of N″.

If, now, a momentary negative current is sent, this effect is reversed. The pole N″, in turn, attracts the armature, and it moves to that side, remaining until the polarity of the exciting-current is again changed.

Thus, by transmitting through the helices of the electro-magnet E a rapidly-alternating series of short positive and negative currents, it will readily be understood that the armature C and its attachments may be caused to vibrate to and fro with great rapidity, causing a correspondingly rapid revolution of the ratchet-wheel H and type-wheel T, and that the latter may readily be brought to any required position simply by transmitting in succession the requisite number of alternate positive and and negative currents through the electro-magnet E. These alternate currents of short duration necessarily traverse the coils of the electro-magnet M, which is included in the same circuit, but the armature of the latter is not affected by them. The reason of this is, that a polarized or permanently magnetic armature responds much more promptly to the attraction of an electro-magnet than a non-polarized or neutral armature, other conditions being the same, and therefore the polarized armature C of the magnet E responds perfectly to the short alternate currents, while the more sluggish non-polarized or neutral armature *l* remains at rest.

In order, therefore, to print an impression of any desired character upon the type-wheel, a succession of alternate positive and negative currents is sent through the wire 1 2 3, Figs. 1 and 3, of such short duration as not to affect in any manner the neutral armature *l* of the electro-magnet M, while by the action of the polarized armature C of the electro-magnet E, the type-wheel T may be revolved until the desired character upon its circumference is brought opposite the impression-lever L. The duration of the final current is then prolonged, the effect of which prolongation is to cause the type-wheel to be firmly locked in its position (the pawl *h* or *h′* being wedged between the point of the stop *i* or *i′* and a tooth of the wheel H,) and to allow sufficient time for the neutral armature *l* of the electro-magnet M to act, which raises the lever L, and brings the paper ribbon in contact with the type upon the wheel T, the same having been previously inked by the fountain-roller I.

The armature *l* being of soft iron and neutral, it is immaterial, so far as the result is concerned, whether the prolonged terminal current is positive or negative, as it responds with equal certainty in either case. When the attraction of the electro-magnet M ceases the lever L falls back to its original position. At the same time the hooked pawl *s* catches a tooth of the ratchet-wheel *r* and causes it, together with the wheel *q*, to revolve a short distance, thus drawing the paper ribbon forward and leaving a clear space in readiness for the next impression.

A click, *x*, prevents the ratchet-wheel *r*, and, consequently, the wheel *q*, from revolving in the opposite direction.

The downward movement of the lever L may be assisted by a retracting - spring, if necessary.

It will be understood from the above description that this apparatus may be actuated entirely by electro-magnetic power, derived from the battery at the transmitting-station, without the assistance of local or secondary batteries, or of mechanical power derived from any source other than the said battery at the said transmitting - station, and that any required number of such apparatus may be placed at various points included in the same electric circuit, and operated simultaneously in unison by the action of a single battery placed at the transmitting-station.

This will be more clearly understood by reference to Fig. 6, where we have given a skeleton diagram illustrating an arrangement of instruments in connection with a main battery and circuit-breaker, whereby an operator can at one point form a connection with a main battery, so as to complete an electric circuit, in such manner that the current of said battery shall pass through as many instruments on a main line unprovided with local batteries as desired, and record simultaneously, in printed characters, at each instrument the same message.

For instance, at a point lettered X there may be located a circuit-breaker of any suitable construction, and at the point lettered Y a main battery of sufficient power, or in lieu thereof a number of small main batteries, located at such point, or elsewhere in the main circuit, that a current may be caused to pass from the main battery or batteries through the electro-magnets I, II, III, &c.

It is obvious that other electro-magnets can be placed in the same circuit for effecting other useful purposes, such as striking bells to call attention, &c., which may be actuated by increasing the strength of the electric current which operates the printing mechanism. It is also obvious that a local battery may be employed to bring into action a magnet not in the same circuit, by insulating one of the stops, *d d′*, upon the standard A, and connecting it with the local circuit in such manner that the rapid vibrations of the arm D will not allow it to remain in contact with the stop long enough to permit the local or secondary battery to charge its electro-magnet; but when the vibrations are made to cease by the action of the transmitting-operator, or otherwise, the arm D will remain in contact with the stop *d′* a sufficient time to allow the secondary electro-magnet to become charged.

We do not confine ourselves to the particular form and arrangement of parts shown in the drawings. There are numerous and well-known means of producing the vibratory movement of a lever by the use of alternate positive and negative currents, in combination with a per-

manent and an electro-magnet acting upon each other, and of applying the same to the movement of a type-wheel. Neither do we wish to confine ourselves to any particular method of producing or transmitting alternate positive and negative currents for the purpose specified, as there are many well-known appliances for these purposes, which have heretofore been used in connection with other printing instruments, and may be employed in like manner with advantage in connection with our improved apparatus.

We claim as our invention—

1. The method, substantially as herein specified, of operating a printing-telegraph by first moving the type-wheel into any required position by the action of alternate positive and negative currents of short and uniform duration, and then locking the type-wheel in such position and at the same time causing the printing to be effected by prolonging the duration of the current last sent, irrespective of its polarity.

2. A type-wheel actuated or controlled by the to-and-fro movements of a polarized armature, under the influence of alternate positive and negative currents of short duration, in combination with an impression device actuated or controlled by a neutral armature, when the arrangement is such that the type-wheel may be locked at any required character, and the neutral armature brought into action to effect the printing of such character, by prolonging the normal duration of one of the said alternate currents, whether positive or negative.

3. The combination of the safety-stops d d' with the stops i i' and armature-lever D, substantially as and for the purpose specified.

In testimony that we claim the foregoing we have hereunto set our hands this 21st day of February, 1877.

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THOS. A. EDISON.

Witnesses:
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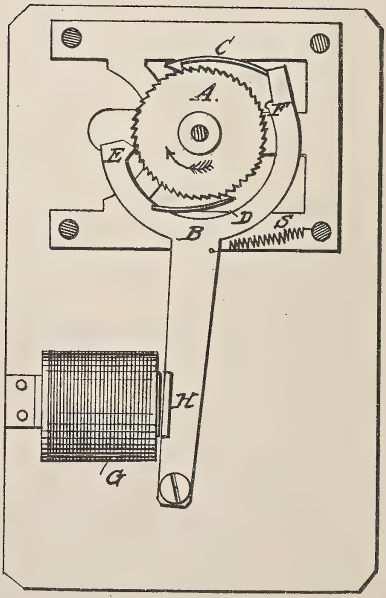
T. A. EDISON.

Printing Telegraph.

No. 103,035.

Patented May 17, 1870.



Witnesses

M. M. Livingston

Frank L. Pope

Inventor

Thomas. A. Edison

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEW YORK, N. Y.

IMPROVEMENT IN ELECTRO-MOTOR ESCAPEMENTS.

Specification forming part of Letters Patent No. **103,035**, dated May 17, 1870.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of the city of New York, in the county and State of New York, have invented certain new and useful Improvements in Electro-Motor Escapements; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing, which forms part of this specification.

The object of this invention is to provide a novel and efficient means whereby an intermittent rotary motion in one direction may be communicated to a wheel and shaft by the vibrations of the armature of an electro-magnet, while at the same time, by simply suspending the action of the electro-magnet, the said wheel and shaft may be securely held at any desired point in its revolution.

In the accompanying drawing, which is a front elevation of my invention, A designates a wheel mounted upon a shaft, *a*, and provided with ratchet-shaped teeth upon its periphery. B is a forked lever, which is movable upon the pivot or arbor *b*, and is provided with two spring pawls or clicks, C and D, which engage with the teeth of the wheel A at two opposite points or sides of its periphery. E and F are stops secured to or formed upon the forked lever B, and these stops are so arranged as to act alternately at opposite points upon the teeth of the wheel A, as will be hereinafter described. G is an electro-magnet, the armature H of which is secured to the lever B. S is a retracting-spring, which retains the lever B in the position shown in the drawing when the electro-magnet G is not in action.

The manner in which this device operates is as follows: When a current of electricity passes through the coil of the electro-magnet G its attraction for the armature H causes the lever B to be moved toward said magnet. The pawl or click D engages with a tooth of the wheel A, and causes it to revolve in the direction shown by the black arrow until its motion is arrested by the stop E coming in contact with another of its teeth, as shown in the drawing. The click D at the same time slips over one tooth of the wheel A.

When the electric current is interrupted, the attractive force of the electro-magnet G is no longer exerted upon the armature H, and the spring S causes the lever B to return to its normal position.

During the latter movement a reverse action takes place by means of the click D and the stop F, the effect of which is to advance the wheel A still farther in the same direction as before. This action may be repeated indefinitely, and an intermittent rotary motion communicated to the wheel A by the vibration of the armature H of the electro-magnet G.

When the lever B is at rest at either extremity of its vibration, one of the stops, E or F, rests between two teeth of the wheel A, thus holding it in the desired position until the lever is again moved.

The ratchet-wheel and escapement, when arranged as described, may be placed upon a shaft midway between the bearings of said shaft without necessarily being placed close to the frame in order to accommodate the stops. In the construction and operation of printing and dial telegraphs this is often a great advantage.

This improved escapement has several important advantages over those employing rigid pawls or clicks pivoted or hinged to the lever of the armature, and having screw-stops attached to the frame. For instance, the jarring and vibrating caused by the rapid movements of the lever in such above-referred-to devices has a tendency to continually loosen the pivots or screws by which the pawls or clicks are attached to the lever, and the same effect is produced upon screw-stops when arranged upon the frame, thereby throwing the apparatus out of proper adjustment.

By the use of spring pawls or clicks permanently attached to the lever, and by arranging the stops upon the lever so as to form a part thereof, as in my present escapement, all danger of the apparatus being thrown out of adjustment by the loosening of any of the parts is entirely obviated.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of the click C, stop E, lever B, and toothed wheel A with the electro-magnet G and armature H, substantially as and for the purposes herein specified.

2. The combination of the click D, stop F, lever B, and toothed wheel A with the electro-magnet G and armature H, substantially as and for the purposes herein specified.

3. The combination, with an electro-magnet, G, of a vibrating lever, B, provided with the stops E F, one or both, and clicks C D, one or both, arranged and operating substantially as herein specified.

4. The combination of the clicks C and D, stops E and F, lever B, spring S, toothed wheel A, armature H, and electro-magnet G, substantially as and for the purpose herein specified.

THOMAS A. EDISON.

Witnesses:

M. M. Livingston,

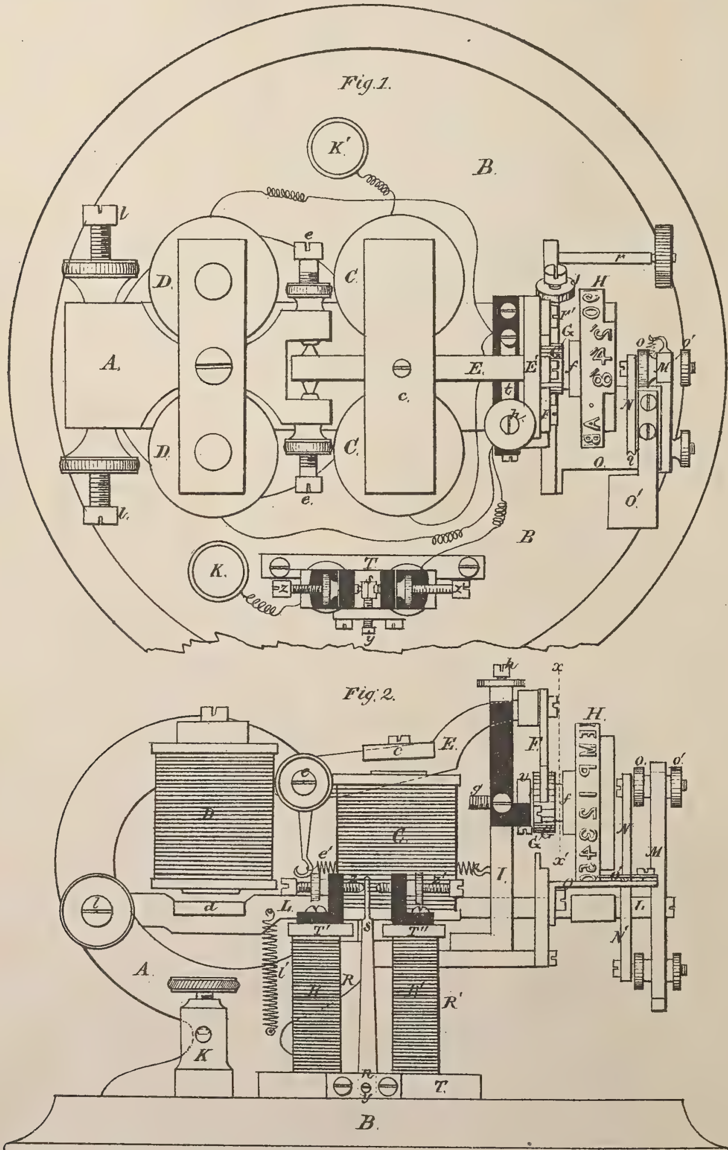
Frank L. Pope.

2 Sheets--Sheet 1.

F. L. POPE & T. A. EDISON.

Printing Telegraphs.

103924. PATENTED JUN 7, 1870.



Witnesses.
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N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

2 Sheets--Sheet 2.

F. L. POPE & T. A. EDISON.

Printing Telegraphs.

103924. PATENTED JUN 7, 1870.

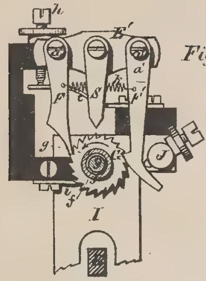


Fig. 3.

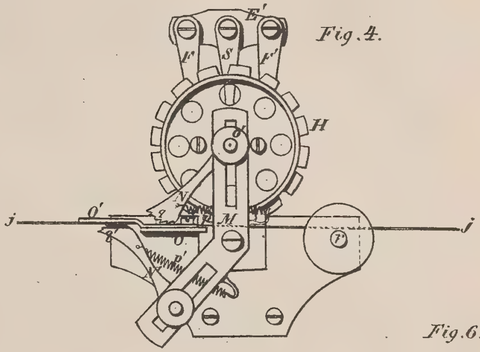


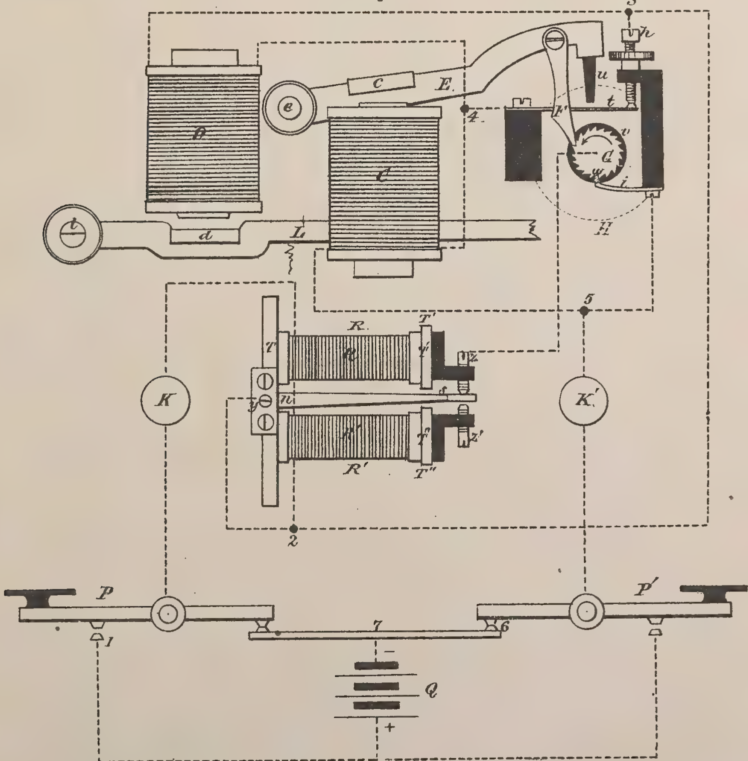
Fig. 4.

Fig. 5.

Fig. 6.

123·1/2·5 8

Fig. 7.



Witnesses; M. M. Livingston
T. R. Beecher

Inventors; Frank L. Pope
Thomas A Edison

UNITED STATES PATENT OFFICE.

FRANK L. POPE, OF ELIZABETH, NEW JERSEY, AND THOMAS A. EDISON, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. **103,924**, dated June 7, 1870.

To all whom it may concern:

Be it known that we, FRANK L. POPE, of Elizabeth, in the county of Union and State of New Jersey, and THOMAS A. EDISON, of the city, county, and State of New York, have invented certain new and useful Improvements in Printing-Telegraphs; and we do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, which forms part of this specification.

The object of this invention is to furnish a telegraphic instrument, by means of which communications may not only be recorded automatically in printed characters at one or more distant points, at the pleasure of the transmitting operator, but by which this result may be accomplished with greater certainty, and in a much more simple manner, than by the apparatus hitherto used for this purpose.

The principal features of this improvement relate, first, to the placing of the electro-magnet which rotates the type-wheel, in the same electrical circuit with a second electro-magnet which operates the printing mechanism, and so arranging them, in connection with an electrical cut-off of a novel construction, that the printing mechanism can only act after the type-wheel has been brought to its desired position; second, to the use of an electrical cut-off, which we term the unison cut-off, and by means of which any number of printing-telegraph instruments may be brought into correspondence with the transmitting-instrument at the pleasure of the transmitting operator; third, to the use of an electro-magnetic switch of peculiar construction, which is employed for the purpose of placing the unison cut-off in circuit, and which may also be made useful for other purposes in connection with printing-telegraph instruments; fourth, to an improved paper-feeding mechanism for printing-telegraph instruments; fifth, to the placing of certain duplicate figures or characters in a peculiar position upon the type-wheel, for purposes hereinafter specified.

The arrangement of the various parts of this invention will be more fully understood by reference to the accompanying drawings, in which—

Figure 1 represents a plan view of the receiving and recording apparatus. Fig. 2 is a side elevation of the same. Fig. 3 is a sectional front view of a portion of the apparatus taken through the line $x\ x'$, Fig. 2. Fig. 4 is a detached front view, showing the device for moving the paper forward beneath the type-wheel. Fig. 5 is a sectional view, showing the details of the unison cut-off. Fig. 6 illustrates the manner in which numbers and fractions are printed by the apparatus. Fig. 7 is a theoretical diagram, designed to show the electrical connections of the various parts of the apparatus, and their relations to each other, whereby the desired results are obtained.

Similar letters and marks of reference indicate like parts in the different figures.

A (see Figs. 1 and 2) designates a metallic frame or standard, which is firmly secured to the pedestal or base B, and which serves as a support to the different portions of the receiving-instrument. An electro-magnet, C, is secured, preferably, in an upright position upon the lower portion of the frame A, and a second similar electro-magnet, D, is placed in a preferably inverted position upon the upper portion of the said frame. The armature c of the electro-magnet C is attached to a lever E, which moves upon pivots $e\ e$ fixed in the upper extremity of the frame A. A pawl, F, Figs. 1, 2, 3, and 4, is pivoted at a to the cross-head E′, at or near the end of the lever E. This pawl engages with the teeth of a ratchet-wheel, G, as shown in Fig. 3. The ratchet-wheel G, and also the type-wheel H, are mounted upon a sleeve, f, which revolves upon a stationary spindle, g, projecting from the standard I, which latter is supported by the frame A. This arrangement will be clearly understood by reference to Figs. 1, 2, and 3. The cross-head E′, Fig. 3, is also provided with a second pawl, F′, which is pivoted at a', and is provided at one end with a hook, which acts upon the opposite side of the wheel G. A stop, S, is permanently secured to the cross-head E′ midway between the pawls F and F′. The pawls F and F′ are kept in contact with the face of the wheel G by means of a spiral spring, K, or in any other suitable manner.

By reference to Fig. 3 it will readily be understood that a downward movement of the lever E and the cross-head E′, caused by the

attraction of the electro-magnet C, will cause the pawl F to engage with a tooth of the ratchet-wheel G, and cause the latter to rotate the distance of half the depth of a tooth in the direction of the black arrow, when its movement is arrested by the stop S coming between the teeth of the wheel G. The pawl F′ has, meantime, passed one tooth of the wheel G, and when the lever E returns to its former position it engages with the said tooth, and rotates the wheel the distance of half the depth of a tooth farther, when its motion is arrested by the stop J. Thus each movement of the lever E in both directions advances the wheel G one tooth in the direction of the black arrow, and an intermittent rotary motion is imparted to said wheel G by the vibrations of the lever E under the influence of the electro-magnet C. This intermittent rotary motion is imparted to the sleeve *f* and the type-wheel H.

The ratchet-wheel G is provided with a number of teeth corresponding to the number of letters, figures, or characters upon the circumference of the type-wheel G, so that the latter may be brought to any desired position by transmitting the appropriate number of electrical pulsations through the electro-magnet C, each pulsation advancing the wheel G one tooth, and the type-wheel H one character, through the medium of the armature *c*, lever E, and pawl F, as hereinbefore explained.

The electrical connections between the different portions of the apparatus are only partially seen in Figs. 1 and 2, but are fully shown in Fig. 7, which will be hereinafter explained.

The apparatus for taking the impression of any desired letter, when the type-wheel has been brought to the proper position, is constructed and operates as follows:

Underneath the electro-magnet D, Fig. 2, is a horizontal lever, L, to which its armature *d* is attached. This lever is capable of a slight vertical motion upon the pivots *l l*. The lever L passes between the helices of the electro-magnet C, and through an aperture in the standard I. The strip of paper *j j*, Fig. 4, passes over the extremity of the lever L and underneath the type-wheel H. When the electro-magnet D becomes sufficiently excited by the passage of the electrical current, its attraction will be exerted upon the armature *d*, thereby raising the lever L and bringing the strip of paper *j j* forcibly in contact with the character upon the type-wheel H, which is over it at the time. The characters upon the type-wheel having been previously inked by means of an ink-roller, or other suitable device, an impression of the said character is made upon the paper. Upon the cessation of the electric current in the coils of the electro-magnet D, the lever L is drawn back to its original position by means of the spring *l′*.

The device for moving the paper forward, after each impression has been made, is constructed and operates as follows:

Upon the end of the lever L there is secured a slotted bar, M, Figs. 1, 2, and 4, which moves vertically with said lever L. To the upper portion of this bar there is attached a feeder, N, by means of adjustable set-screws *o* and *o′*, which allow of its being secured at any desired point upon the bar M. The feeder N is placed in an inclined position, as shown in Fig. 4, its lower extremity being serrated, or provided with spurs *q′*, and resting upon the strip of paper *j j*, which, at that point, is supported by the bed-plate O. The feeder N is kept in contact with the paper by means of a spiral spring, *q*. A second feeder, N′, is attached in the same manner to the lower part of the bar M, so as to rest against the under side of the strip of paper at *q′*, which paper passes underneath the plate O′, as shown in Figs. 1, 2, and 4.

By an inspection of Fig. 4 it will be understood that, when the lever L′ and its bar M descends after an impression has been made, the lower end of the feeder N is thrust to the left, and the paper is pushed forward by its spurs *q*. When the lever L is again moved upward the feeder N′ in the same manner advances the paper still farther to the left. By this arrangement the feeders N and N′ may be so adjusted that a comparatively slight vertical movement of the lever L will cause a considerable horizontal movement of the strip of paper *j j*, and the amount of this movement may be regulated at pleasure by altering the position of the set-screws *o* and *o′* upon the bar M.

The manner in which the several parts of the apparatus are electrically connected and operated will be understood by reference to Fig. 7, which is a theoretical diagram, showing the various parts heretofore described in relation to each other, and with their proper electrical connections.

In Fig. 7, Q represents a voltaic battery of any suitable construction, the positive and negative poles of said battery being distinguished in the drawing by the signs + and −. P is a key or circuit-breaker, which may be of any suitable construction. The battery Q and key P it is to be understood are situated at the transmitting-station. By means of the circuit-breaker P a series of successive pulsations may be transmitted through the conducting-wires and the electro-magnets of the receiving apparatus. Starting from the positive pole of the battery Q, the circuit may be traced to the anvil 1 of the key *p*; thence through the electro-magnet R R′, for purposes which will be hereinafter explained, to the point 2, and thence to the point 3. From the point 3 to the point 4 two routes are open to the current—one through the helices of the electro-magnet D, and the other through the screw *h* and flat spring *t*. The latter route being much the shortest, and offering little or no resistance to the passage of the current, the electro-magnet D will not be perceptibly affected by the passage of the current as long as the branch circuit through *h* and *t* remains uninterrupted. From the point 4 the current passes through

the helices of the electro-magnet C to the point 5, and thence, by 6 and 7, to the other pole of the battery Q. When the lever E is drawn down by the action of the electro-magnet C, an insulated pin, *u*, Fig. 7, strikes the spring *t* just before the movement of the former is arrested, and breaks the electrical contact between it and the screw *h*. The entire current is therefore momentarily thrown through the helices of the electro-magnet D at each vibration of the lever E; but when these vibrations are performed with considerable rapidity, the electro-magnet D is not kept in circuit long enough to become completely magnetized. When the circuit remains closed for a longer time, the electro-magnet D becomes fully magnetized and attracts its armature *d*, thereby raising the lever L and bringing the strip of paper *j j* against the type upon the type-wheel H.

It will therefore be understood from the above explanation that the impression of any given character upon the type-wheel H may be produced upon the paper *j j* by an operator stationed at a distant point, as, for example, at P, (see Fig. 7,) simply by transmitting the proper number of electrical impulses of short duration by means of a properly-constructed circuit-breaker, which will cause the type-wheel H to revolve without sensibly affecting the impression device. When the desired character is brought opposite the impression-lever L the duration of the final current is prolonged, and the electro-magnet D becomes fully magnetized, and therefore an impression of the letter or character upon the paper is produced, in the manner hereinbefore described.

When a number of automatic printing-telegraph instruments is situated at different points, and operated simultaneously in one circuit, it is desirable that some suitable means may be provided whereby the transmitting-operator may be enabled to bring the type-wheels of the several receiving or recording instruments into correspondence at pleasure.

This is effected by the following device: Upon the sleeve *f*, which carries the type-wheel H and ratchet-wheel G, is secured a collar, *v*, Figs. 2, 5, and 7. This collar is composed of some suitable insulating material. We will here observe that in all the figures the non-conducting material employed to insulate one portion of the apparatus from another is represented in deep black color. A metallic spring, *i*, fixed upon an insulating support, Figs. 5 and 7, presses against this collar as it revolves. A metallic pin or stud, *w*, is inserted into the sleeve *f*, passing through the insulating collar, as shown in Figs. 5 and 7, in such a manner as to form an electrical connection between the sleeve *f* and the spring *i* whenever the pin or stud *w* is brought in contact with said spring by the revolution of the sleeve *f*. This arrangement is clearly shown in Figs. 5 and 7. By reference to Fig. 7, in which the electrical connections are shown in dotted lines, it will be understood that this connection forms a short circuit between the point 2 and the point 5, cutting off nearly all the electric current from the electro-magnets C and D, and thereby arresting their action. This short circuit may be brought into action at the pleasure of the transmitting operator, by means of the device we will now describe. R R′, Figs. 2 and 7, designate the helices of a small electro-magnet whose poles are shown at T′ and T″, the opposite ends of the cores being screwed into the soft-iron bar T. A permanently-magnetized steel-bar, *n s*, is pivoted to the bar T at *y*, its opposite extremity being free to vibrate between the screws *z* and *z*′. In consequence of a well-known law of magnetic action, when a current from the battery Q passes through the helices of the electro-magnet R R′ in one direction, the south end *s* of the magnetic bar *n s* will be attracted by T′ and repelled by T″, while a current in the opposite direction will produce the reverse effect. One pole of the polarized bar *n s* being in magnetic contact with the mass of soft iron formed by the bar T and its attachments, its magnetism cannot be weakened or reversed, as is often the case with magnetized armatures, which are not in magnetic contact with the soft iron of the electro-magnet. From this explanation, and by reference to Fig. 7, it will be readily understood that the transmitting operator, by employing the circuit-breaker P′ instead of P, can send a series of electrical pulsations through the circuit in the opposite direction, which will cause the south end *s* of the bar *n s* to be deflected toward T′, so as to come in contact with the stop *z*. As it is a matter of indifference in which direction the current passes through the electro-magnet C, in order to operate it, the type-wheel of each instrument will continue to revolve by its action, as usual, until the pin or stud *w* comes in contact with the spring *i*, when a short circuit will be formed from 2, Fig. 7, through *n*, *s*, and *z*, to the metallic frame of the instrument, and thence through sleeve *f*, pin or stud *w*, and spring *i* to the point 5, and thence by the usual route. The principal part of the current will take the shorter route just described, and the action of the electro-magnet C, and consequently the movement of the type-wheel H, will be arrested. Each instrument in the circuit will therefore stop automatically at the same point in the revolution of the type-wheel H and sleeve *f*. When this has been accomplished the electric current is again reversed, and the operation of the apparatus proceeds as usual.

When the instrument hereinbefore described is intended to be used for reporting quotations of markets, &c., wherein the amounts to be represented fluctuate by eighths of one per cent., three duplicate figures or characters are placed upon the periphery of the type-wheel H in such a position as to impress themselves upon the strip of paper lower than the line of the other figures or characters upon the wheel,

which may be used, in combination with the ordinary numerals, to indicate fractional quantities. The arrangement of these characters upon the type-wheel is shown in Fig. 1, and the manner in which their impressions upon the paper are combined with those of the numerals to represent fractional quantities is shown in Fig. 6.

By means of this device, the total number of characters upon the type-wheel may be considerably reduced and the speed of transmission correspondently augmented.

It is obvious that letters as well as other characters may be placed upon the type-wheel, in a different circumferential plane, in the same manner as the figures just referred to, and in such cases the letters, figures, or characters in the one circumferential plane would be opposite blank spaces in the other circumferential plane, and hence no two letters, figures, or characters would be in the same axial plane.

This arrangement of letters, figures, or characters upon the type-wheel of a printing-telegraph we believe to be new.

We do not claim, distinctively, the placing of an electro-magnet for operating the type-wheel of a printing-telegraph instrument in the same circuit with the electro-magnet that actuates the printing mechanism; nor do we claim, in general, the use of a device for bringing the transmitting and receiving apparatus into unison from the transmitting-station, as this is shown in the patent granted to Charles Kirchof, April 15, 1856, and also in the patent granted to S. S. Laws, January 25, 1870.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In a printing-telegraph instrument, the arrangement of two electro-magnets in the same electrical circuit, one being employed to rotate the type-wheel and the other to actuate the printing mechanism, when the action of the latter is controlled by that of the former, by means of a branch or short circuit and a mechanical cut-off or its equivalent, constructed and operated substantially as described.

2. An improved cut-off, which we term an electrical unison cut-off, whereby, at a given point in the revolution of a ratchet or type wheel, a shunt or branch circuit may be brought into action, and the electrical current diverted from the electro-magnet controlling the movement of the said ratchet or type wheel, so that the said movement may be arrested at such given point, the same being constructed and operated substantially as specified.

3. The electro-magnet R R′ and soft-iron bar T, in combination with a polarized steel bar, *n s*, so arranged that said steel bar will be in magnetic contact with the said soft-iron bar, substantially as herein specified.

4. The bar M, feeders N and N′, (either or both,) spurs *q* and *q′*, (either or both,) bed-plates *o* and *o′*, (either or both,) combined, arranged, and operating substantially as described, and for the purpose specified.

5. The combination of the lever E, pawls F and F′, stops S and J, and ratchet-wheel G, arranged and operated substantially as described.

6. The combination of the pawl F, stop S, and ratchet-wheel G, substantially as and for the purpose specified.

7. The electro-magnets R R′, soft-iron bar T, and polarized-steel bar *n s*, in combination with the spring *i*, insulated collar *v*, and pin or stud *w*, in the manner described, and for the purpose specified.

8. The combination, with an electro-magnet, in a telegraphic printing apparatus, of a type-wheel whose periphery is provided with integral numbers so arranged upon said type-wheel that fractions of numbers may be printed upon the paper, thereby decreasing the number of characters upon the type-wheel, and insuring great rapidity in recording, substantially as herein shown and described.

9. In a printing-telegraph, a type-wheel provided with letters, figures, or characters, which are arranged in two different lines drawn around the periphery of said wheel, and in such manner that the said letters, figures, or characters in the one line shall be opposite blank spaces in the other line, substantially as herein specified.

FRANK L. POPE.
THOMAS A. EDISON.

Witnesses:
M. M. LIVINGSTON,
T. B. BEECHER.

2 Sheets--Sheet 1.

F. L. POPE & T. A. EDISON.

Printing Telegraphs.

No. 5,523. Reissued August 5, 1873.

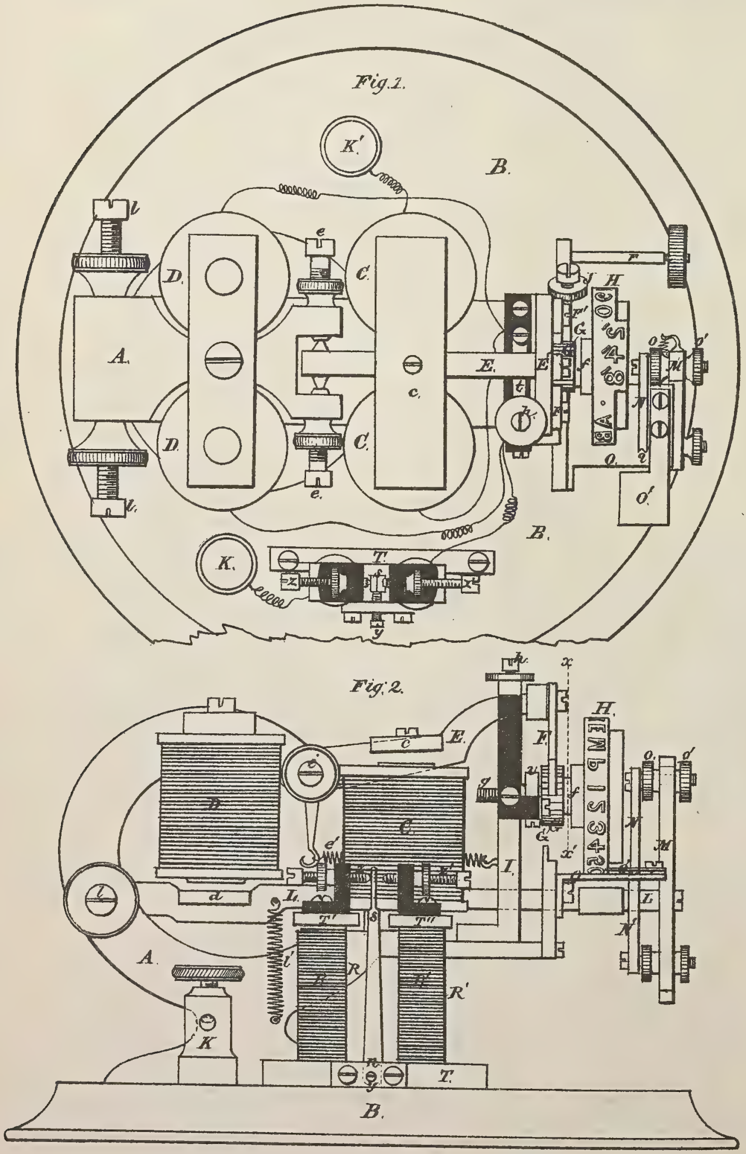


Fig. 1.

Fig. 2.

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2 Sheets--Sheet 2.

F. L. POPE & T. A. EDISON.

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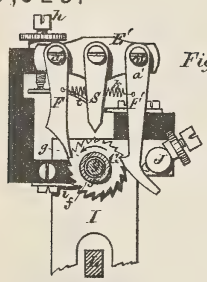


Fig.3.

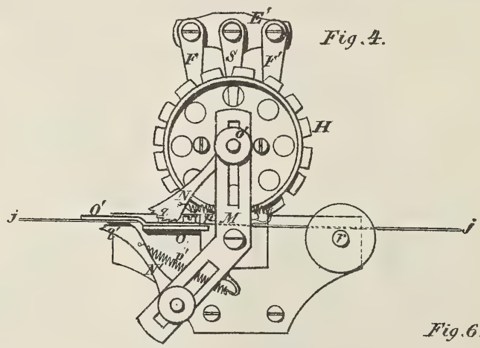


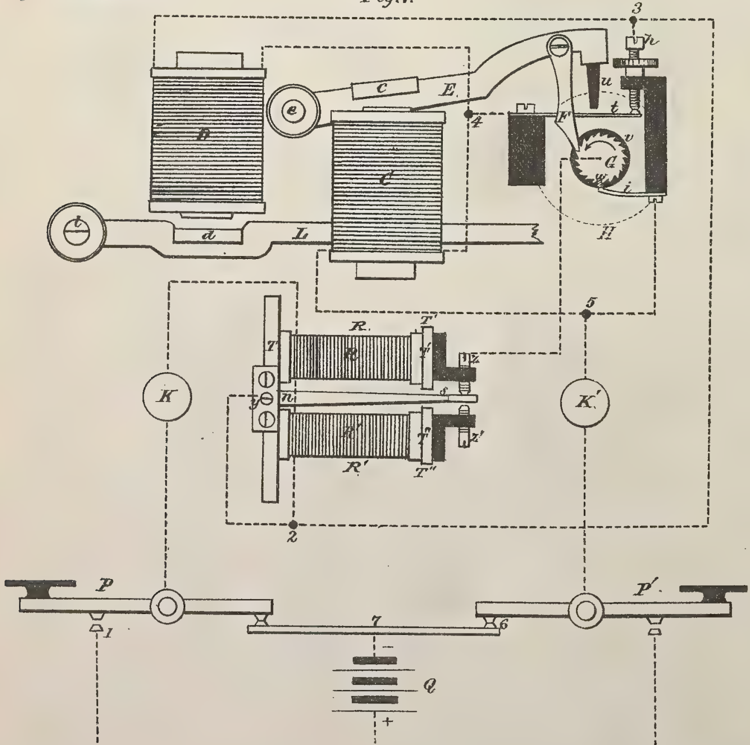
Fig.4.

Fig. 5.

Fig.6.

123·1/2·58

Fig.7.



Witnesses; M. M. Livingston
T. B. Beecher

Inventors; Frank L. Pope
Thomas A. Edison

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

United States Patent Office.

FRANK L. POPE, OF ELIZABETH, AND THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNORS, BY MESNE ASSIGNMENTS, TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 103,924, dated June 7, 1870; reissue No. **5,523**, dated August 5, 1873; application filed June 19, 1873.

To all whom it may concern:

Be it known that we, FRANK L. POPE, of Elizabeth, in the county of Union and State of New Jersey, and THOMAS A. EDISON, formerly of the city and State of New York, now of Newark, in the county of Essex and State of New Jersey, have invented Improvements in Printing-Telegraphs, of which the following is a specification:

The object of this invention is to furnish a telegraphic instrument by means of which communications may not only be recorded automatically, in printed characters, at one or more distant points, at the pleasure of the transmitting-operator, but by which this result may be accomplished with greater certainty, and in a much more simple manner, than by the apparatus hitherto used for this purpose.

The principal features of this improvement may be stated as follows: First, to the placing of the electro-magnet which rotates the type-wheel in the same electrical circuit with a second electro-magnet which operates the printing mechanism, and so arranging them that the printing mechanism will act in consequence of a pause when the type-wheel has been brought to its desired position. Second, to a shunt applied in the circuit that passes to the printing and type wheel electro-magnets, to intensify the action of the printing-magnet after the type-wheel has been set, whereby the rapidity of the instrument will be promoted without necessarily increasing the power of the battery. Third, to the use of an electrical cut-off, which we term the unison cut-off, and by means of which any number of printing-telegraph instruments may be brought into correspondence with the transmitting instrument at the pleasure of the transmitting-operator. Fourth, to the use of an electro-magnetic switch of peculiar construction, which is employed for the purpose of placing the unison cut-off in circuit, and which may also be made useful for other purposes in connection with printing-telegraph instruments. Fifth, to an improved paper-feeding mechanism for printing-telegraph instruments. Sixth, to the placing of certain duplicate figures or characters in a peculiar position upon the type-wheel, for purposes hereinafter specified.

The arrangement of the various parts of this invention will be more fully understood by reference to the accompanying drawing, in which—

Figure 1 represents a plan view of the receiving and recording apparatus. Fig. 2 is a side elevation of the same. Fig. 3 is a sectional front view of a portion of the apparatus taken through the line x x', Fig. 2. Fig. 4 is a detached front view, showing the device for moving the paper forward beneath the type-wheel. Fig. 5 is a sectional view, showing the details of the unison cut-off. Fig. 6 illustrates the manner in which numbers and fractions are printed by the apparatus. Fig. 7 is a theoretical diagram designed to show the electrical connections of the various parts of the apparatus and their relations to each other, whereby the desired results are obtained.

A (see Figs. 1 and 2) designates a metallic frame or standard, which is firmly secured to the pedestal or base *b*, and which serves as a support to the different portions of the receiving instrument. An electro-magnet, C, is secured, preferably in an upright position, upon the lower portion of the frame A, and a second similar electro-magnet, D, is placed, in a preferably inverted position, upon the upper portion of the said frame. The armature *c* of the electro-magnet C is attached to a lever, *e*, which moves upon pivots *e e* fixed in the upper extremity of the frame A. A pawl, F, Figs. 1, 2, 3, and 4, is pivoted at *a* to the cross-head E′ at or near the end of the lever E. This pawl engages with the teeth of a ratchet-wheel, G, as shown in Fig. 3. The ratchet-wheel G, and also the type-wheel H, are mounted upon a sleeve, *f*, which revolves upon a stationary spindle, *g*, projecting from the standard I, which latter is supported by the frame A. This arrangement will be clearly understood by reference to Figs. 1, 2, and 3. The cross-head E′, Fig. 3, is also provided with a second pawl, F′,

which is pivoted at a', and is provided at one end with a hook, which acts upon the opposite side of the wheel G. A stop, S, is permanently secured to the cross-head E′ midway between the pawls F and F′. The pawls F and F′ are kept in contact with the face of the wheel G by means of a spring, K, or in any other suitable manner.

By reference to Fig. 3 it will readily be understood that a downward movement of the lever E and the cross-head E′, caused by the attraction of the electro-magnet C, will cause the pawl F to engage with a tooth of the ratchet-wheel G, and cause the latter to rotate the distance of half the depth of the tooth in the direction of the arrow, when its movement is arrested by the stop S coming between the teeth of the wheel G. The pawl F′ has meantime passed one tooth of the wheel G, and when the lever E returns to its former position it engages with the said tooth and rotates the wheel the distance of half the depth of a tooth farther, when its motion is arrested by the stop J. Thus each movement of the lever E, in both directions, advances the wheel G one tooth in the direction of the arrow, and an intermittent rotary motion is imparted to said wheel G by the vibrations of the lever E under the influence of the electro-magnet C. This intermittent rotary motion is imparted to the sleeve *f* and the type-wheel H. The ratchet-wheel G is provided with a number of teeth corresponding to the number of letters, figures, or characters upon the circumference of the type-wheel G, so that the latter may be brought to any desired position by transmitting the appropriate number of electrical pulsations through the electro-magnet C, each pulsation advancing the wheel G one tooth, and the type-wheel H one character, through the medium of the armature *c*, lever E, and pawl F, as hereinbefore explained.

The electrical connections between the different portions of the apparatus are only partially seen in Figs. 1 and 2, but are fully shown in Fig. 7, which will be hereafter explained.

The apparatus for taking the impression of any desired letter, when the type-wheel has been brought to the proper position, is constructed and operates as follows: Underneath the electro-magnet D, Fig. 2, is a horizontal lever, L, to which its armature *d* is attached. This lever is capable of a slight vertical motion upon the pivots *l l*. The lever L passes between the helices of the electro-magnet C, and through an aperture in the standard I. The strip of paper *j j*, Fig. 4, passes over the extremity of the lever L and underneath the type-wheel H. When the electro-magnet D becomes sufficiently excited by the passage of the electrical current its attraction will be exerted upon the armature *d*, thereby raising the lever L and bringing the strip of paper *j j* forcibly in contact with the character upon the type-wheel H, which is over it at the time. The characters upon the type-wheel having been previously inked by means of an inking-roller or other suitable device, an impression of the said character is made upon the paper. Upon the cessation of the electric current in the coils of the electro-magnet D the lever L is drawn back to its original position by means of the spring l'.

The device for moving the paper forward after each impression has been made is constructed and operates as follows: Upon the end of the lever L there is secured a slotted bar, M, Figs. 1, 2, and 4, which moves vertically with said lever L. To the upper portion of this bar there is attached a feeder, N, by means of adjustable set-screws *o* and o', which allow of its being secured at any desired point upon the bar M. The feeder N is placed in an inclined position, as shown in Fig. 4, its lower extremity being serrated or provided with spurs q' and resting upon the strip of paper *j j*, which at that point is supported by the bed-plate O. The feeder N is kept in contact with the paper by means of a spiral spring, *q*. A second feeder, N′, is attached in the same manner to the lower part of the bar M, so as to rest against the under side of the strip of paper at q', which paper passes underneath the plate O′, as shown in Figs. 1, 2, and 4. By an inspection of Fig. 4 it will be understood that when the lever L and its bar M descend, after an impression has been made, the lower end of the feeder N is thrust to the left, and the paper is pushed forward by its spurs *q*. When the lever L is again moved upward the feeder N′ in the same manner advances the paper still farther to the left. By this arrangement the feeders N and N′ may be so adjusted that a comparatively slight vertical movement of the lever L will cause a considerable horizontal movement of the strip of paper *j j*, and the amount of this movement may be regulated at pleasure by altering the position of the set-screws *o* and *o* upon the bar M.

The manner in which the several parts of the apparatus are electrically connected and operated will be understood by reference to Fig. 7, which is a theoretical diagram showing the various parts heretofore described, in relation to each other and with their proper electrical connections.

In Fig. 7, Q represents a voltaic battery of any suitable construction, the positive and negative poles of said battery being distinguished in the drawing by the signs + and —. P is a key or circuit-breaker, which may be of any suitable construction. The battery Q and key P, it is to be understood, are situated at the transmitting-station. By means of the circuit-breaker P a series of successive pulsations may be transmitted through the conducting-wires and the electro-magnets of the receiving apparatus. Starting from the positive pole of the battery Q, the circuit may be traced to the anvil 1 of the key P, thence through the electro-magnet R R, (for purposes hereinafter explained,) to the point 2, and thence to the point 3. From the point 3 to the point 4 two routes are open to the current, one through the hel-

ices of the electro-magnet D and the other through the screw h and flat spring t. The latter route being much the shortest and offering little or no resistance to the passage of the current, the electro-magnet D will not be perceptibly affected by the passage of the current as long as the branch circuit through h and t remains uninterrupted. From the point 4 the current passes through the helices of the electro-magnet C to the point 5, and thence by 6 and 7 to the other pole of the battery Q. When the lever E is drawn down by the action of the electro-magnet C an insulated pin, u, Fig. 7, strikes the spring t just before the movement of the former is arrested, and breaks the electrical contact between it and the screw h. The entire current is therefore momentarily thrown through the helices of the electro-magnet D at each vibration of the lever E; but when these vibrations are performed with considerable rapidity the electro-magnet D is not kept in circuit long enough to become completely magnetized. When the circuit remains closed for a longer time the electro-magnet D becomes fully magnetized and attracts its armature d, thereby raising the lever L and bringing the strip of paper j j against the type upon the type-wheel H.

It will therefore be understood from the above explanation that the impression of any given character upon the type-wheel H may be produced upon the paper j j by an operator stationed at a distant point—as, for example, at P (see Fig. 7)—simply by transmitting the proper number of electrical impulses of short duration by means of a properly-constructed circuit-breaker, which will cause the type-wheel H to revolve without sensibly affecting the impression device.

When the desired character is brought opposite the impression-lever L the duration of the final current is prolonged, and the electro-magnet D becomes fully magnetized, and therefore an impression of the letter or character upon the paper is produced in the same manner hereinbefore described.

When a number of automatic printing-telegraph instruments are situated at different points and operated simultaneously in one circuit, it is desirable that some suitable means may be provided whereby the transmitting-operator may be enabled to bring the type-wheels of the several receiving or recording instruments into correspondence at pleasure. This is effected by the following device: Upon the sleeve f, which carries the type-wheel H and ratchet-wheel G, is secured a collar, v, Figs. 2, 5, and 7. This collar is composed of some suitable insulating material. We will here observe that in all the figures the non-conducting material employed to insulate one portion of the apparatus from another is represented in black. A metallic spring, i, fixed upon an insulating-support, Figs. 5 and 7, presses against this collar as it revolves. A metallic pin or stud, w, is inserted into the sleeve f, passing through the insulating-collar, as shown in Figs. 5 and 7, in such a manner as to form an electrical connection between the sleeve f and the spring i whenever the pin or stud w is brought in contact with said spring by the revolution of the sleeve f. This arrangement is clearly shown in Figs. 5. and 7.

By reference to Fig. 7, in which the electrical connections are shown in dotted lines, it will be understood that this connection forms a short circuit between the point 2 and the point 5, cutting off nearly all the electric current from the electro-magnets C and D, and thereby arresting their action. This short circuit may be brought into action at the pleasure of the transmitting-operator by means of the device next described. R R′, Figs. 3 and 7, designate the helices of a small electro-magnet, whose poles are shown at T^1 and T^2, the opposite ends of the cores being screwed into the soft-iron bar T. A permanently-magnetized steel bar, n s, is pivoted to the bar T at y, its opposite extremities being free to vibrate between the screws Z and Z′.

In consequence of a well-known law of magnetic action, when a current from the battery Q passes through the helices of the electro-magnet R R′ in one direction the south end s of the magnet-bar n s will be attracted by T^1 and repelled by T^2, while a current in the opposite direction will produce the reverse effect. One pole of the polarized bar n s being in magnetic contact with the mass of soft iron formed by the bar T and its attachments, its magnetism cannot be weakened or reversed, as is often the case with magnetized armatures which are not in magnetic contact with the soft iron of the electro-magnet.

From this explanation, and by reference to Fig. 7, it will be readily understood that the transmitting-operator, by employing the circuit-breaker P′ instead of P, can send a series of electrical pulsations through the circuit in the opposite direction, which will cause the south end s of the bar n s to be deflected toward T^1, so as to come in contact with the stop z.

As it is a matter of indifference in which direction the current passes through the electro-magnet C in order to operate it, the type-wheel of each instrument will continue to revolve by its action, as usual, until the pin or stud w comes in contact with the spring i, when a short circuit will be formed from 2, Fig. 7, through n, s, and z, to the metallic frame of the instrument, and thence through sleeve f, pin or stud w, and spring i, to the point 5, and thence by the usual route. The principal part of the current will take the shorter route, just described, and the action of the electro-magnet C, and, consequently, the movement of the type-wheel H, will be arrested. Each instrument in the circuit will therefore stop automatically at the same point in the revolution of the type-wheel H and sleeve f. When this has been accomplished the electric cur-

rent is again reversed, and the operation of the apparatus proceeds as usual.

When the instrument hereinbefore described is intended to be used for recording quotations of markets, &c., wherein the amounts to be represented fluctuate by eighths of one per cent., three duplicate figures or characters are placed upon the periphery of the type-wheel H in such a position as to impress themselves upon the strip of paper lower than the line of the other figures or characters upon the wheel, which may be used in combination with the ordinary numerals to indicate fractional quantities. The arrangement of these characters upon the type-wheel is shown in Fig. 1, and the manner in which their impressions upon the paper are combined with those of the numerals to represent fractional quantities is shown in Fig. 6. By means of this device the total number of characters upon the type-wheel may be considerably reduced, and the speed of transmission correspondingly augmented.

It is obvious that letters as well as characters may be placed upon the type-wheel in a different circumferential plane in the same manner as the figures just referred to, and in such cases the letters, figures, or characters in the one circumferential plane would be opposite blank spaces in the other circumferential plane, and hence no two letters, figures, or characters would be in the same axial plane. This arrangement of letters, figures, or characters upon the type-wheel of a printing-telegraph we believe to be new.

No claim is made to an electro-magnet for operating the type-wheel of a printing-telegraph instrument in the same circuit with the electro-magnet that actuates the printing mechanism; nor to the use of a device for bringing the transmitting and receiving apparatus into unison from the transmitting-station, as this is shown in the patent granted to Charles Kirchof, April 15, 1856, and also in the patent granted to S. S. Laws, January 25, 1870.

What is claimed as the invention of said F. L. Pope and T. A. Edison is—

1. In a printing-telegraph instrument, the arrangement of two electro-magnets in the same electrical circuit, one being employed to rotate the type-wheel and the other to actuate the printing mechanism, when the action of the latter is controlled by that of the former by means of a branch or short circuit and a mechanical cut-off, or its equivalent, constructed and operated substantially as described.

2. An improved cut-off, termed an electrical-unison cut-off, whereby, at a given point in the revolution of a ratchet or type wheel, a shunt or branch circuit may be brought into action, and the electrical current diverted from the electro-magnet controlling the movement of the said ratchet or type wheel, so that the said movement may be arrested at such given point, the same being constructed and operated substantially as specified.

3. The electro-magnet R R′ and soft-iron bar T, in combination with a polarized-steel bar, *n s*, so arranged that said steel bar will be in magnetic contact with the said soft-iron bar, substantially as herein specified.

4. The bar M, feeder N or N′, spurs *q* or *q′*, bed-plates O or O′, combined, arranged, and operating substantially as described, and for the purposes specified.

5. The combination of the lever E, pawls F and F′, stops S and J, and ratchet-wheel G, arranged and operating substantially as described.

6. The combination of the pawl F, stop S, and ratchet-wheel G, substantially as and for the purposes specified.

7. The electro-magnet R R′, soft-iron bar T, and polarized-steel bar *n s*, in combination with the spring *i*, insulated collar *v*, and pin or stud *w*, in the manner described, and for the purposes specified.

8. The combination, with an electro-magnet in a telegraphic-printing apparatus, of a type-wheel whose periphery is provided with integral numbers, so arranged upon said type-wheel that fractions of numbers may be printed upon the paper, thereby decreasing the number of characters upon the type-wheel and insuring great rapidity in recording, substantially as herein shown and described.

9. In a printing-telegraph, a type-wheel provided with letters, figures, or characters, which are arranged in two different lines around the periphery of said wheel, and in such manner that the said letters, figures, or characters in the one line shall be opposite blank spaces in the other line, substantially as herein specified.

10. A printing-telegraph instrument with the metallic circuit of the main line passing through both the type-wheel and the printing electro-magnets, in combination with a shunt circuit or switch that operates to energize the printing-magnet during a pause after the type-wheel has been set.

Signed this 16th day of June, A. D. 1873.

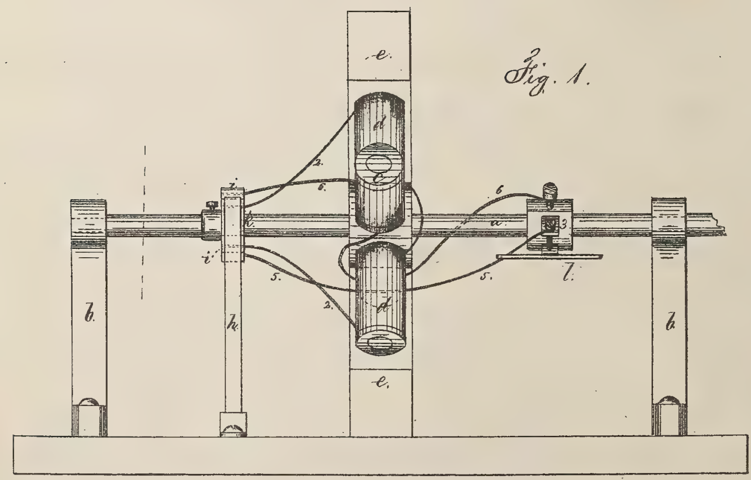
MARSHALL LEFFERTS,
President the Gold and Stock Telegraph Co.
NORMAN C. MILLER,
Secretary.

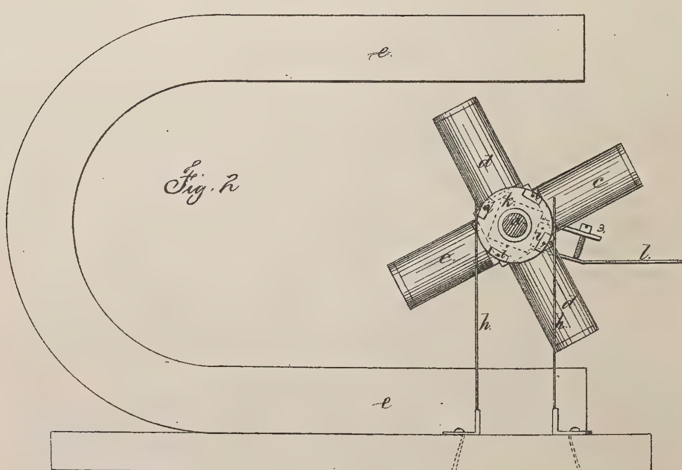
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Electro-Motor Governor.

No. 111,112. Patented Jan. 24, 1871.





Witnesses,

Chas. H. Smith

Geo. T. Pinckney

Thomas A. Edison

Lemuel W. Serrell Atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

United States Patent Office.

THOMAS A. EDISON OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF, ELISHA W. ANDREWS, GEORGE B. FIELD, AND MARSHALL LEFFERTS, OF NEW YORK, N. Y.

Letters Patent No. 111,112, dated January 24, 1871.

IMPROVEMENT IN GOVERNORS FOR ELECTRO-MOTORS.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an improvement in Electro-Motor Governors, and the following is declared to be a correct description thereof.

Electro-motors have heretofore been made by revolving armatures and stationary electro-magnets, and also by revolving electro-magnets and stationary armatures.

My invention is designed for regulating the speed of a revolving electro-magnetic motor by breaking the circuit through one or more of the magnets in case the speed increases beyond the set limit, so as to lessen the power of rotation.

This is effected by a spring or yielding rotary fly acting against the air, but keeping the circuit through it closed, except when the speed of rotation is such that the resistance of the atmosphere causes the arm of the fly to move and break the electrical circuit, so that one or more of the revolving magnets are not charged until the speed lessens sufficiently to allow the fan to close the circuit.

In the drawing—

Figure 1 is an elevation endwise of the revolving shaft that carries the electro-magnets; and

Figure 2 is a side view of the said shaft and parts connected therewith.

The shaft *a* is mounted to revolve in suitable bearings, *b b*, and carries a series of electro-magnets, *c c d d*. I have shown two pairs of such magnets, but the number may be increased.

The stationary permanent magnet *e* is shown, within which the magnets *c c d d* revolve, and said permanent magnet *e*, by the attraction and repulsion of the respective poles of the electro-magnets, produces the rotation of the shaft *a* and magnets *c c d d*, as heretofore well known.

I here remark that stationary armatures might take the place of the magnet *e*, and that the circuits of the magnets *c c d d* are opened and closed by the revolution of the shaft *a*.

The insulated blocks *i i*, in the hub *k*, are connected by wires with the coils in the respective magnets *c c d d*, and the springs *h h*, that impinge upon the periphery of the hub *k*, are connected with a proper battery, either directly or by wires passing through other machinery, or to a distant station.

The blocks *i* are connected in pairs, two on opposite sides, having wires 2 2 leading to the electro-magnets *d d*, the helices of which magnets *d d* are connected.

The other pair of blocks *i i* are connected, the wire 5 passing to the insulated adjusting-screw 3, and yielding-fan *l*, thence by the wire 6 to the magnets *c c*, and through them to the other or opposite block *i*, upon the hub *k*.

It will now be understood that the screw 3 can be adjusted so that when the revolving shaft *a* reaches its maximum speed, the circuit through the wires 5 and 6, screw 3, and fan *l*, will be broken, and the power of the motor be lessened by the magnets *c c* ceasing to act, and so soon as the speed of the motor is lessened, the yielding fly again closes the circuit.

By means of the alternate closing and breaking of the circuit according to the speed, a nearly uniform velocity of the motor is insured; hence two or more instruments can be propelled at almost the same speed, even at distant stations, the regulation of the speed being by the screw 3.

I claim as my invention—

A yielding fly rotating against the atmospheric resistance, and so arranged as to break or close an electrical circuit, in combination with a revolving electro-magnetic motor, substantially as and for the purposes set forth.

Signed by me this 29th day of June, A. D. 1870.

Witnesses: THOMAS A. EDISON.

CHAS. H. SMITH,

GEO. T. PINCKNEY.

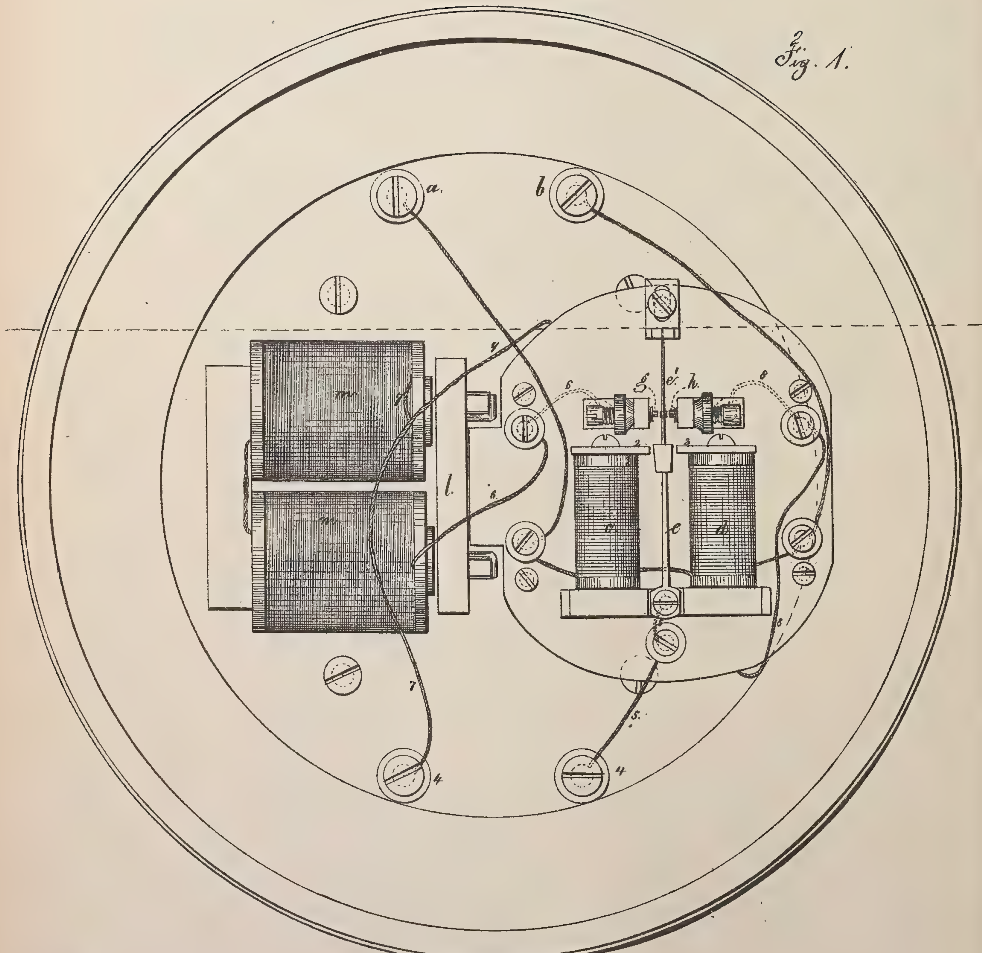
2 Sheets—Sheet 1.

T. A. EDISON.

Printing Telegraph.

No. 113,033. Patented March 28, 1871.

Fig. 1.

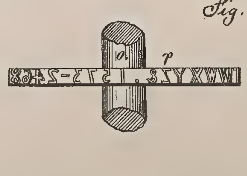


Witnesses,

Chas H Smith

Geo. D Walker

Fig. 4.



Thomas A. Edison

Lemuel W. Serrell atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

2 Sheets—Sheet 2.

T. A. EDISON.

Printing Telegraph.

No. 113,033. Patented March 28, 1871.

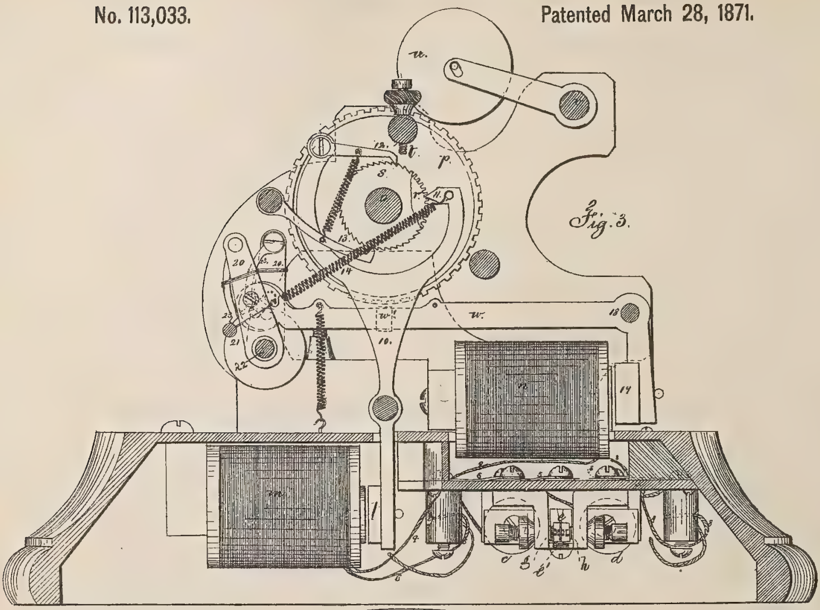


Fig. 3.

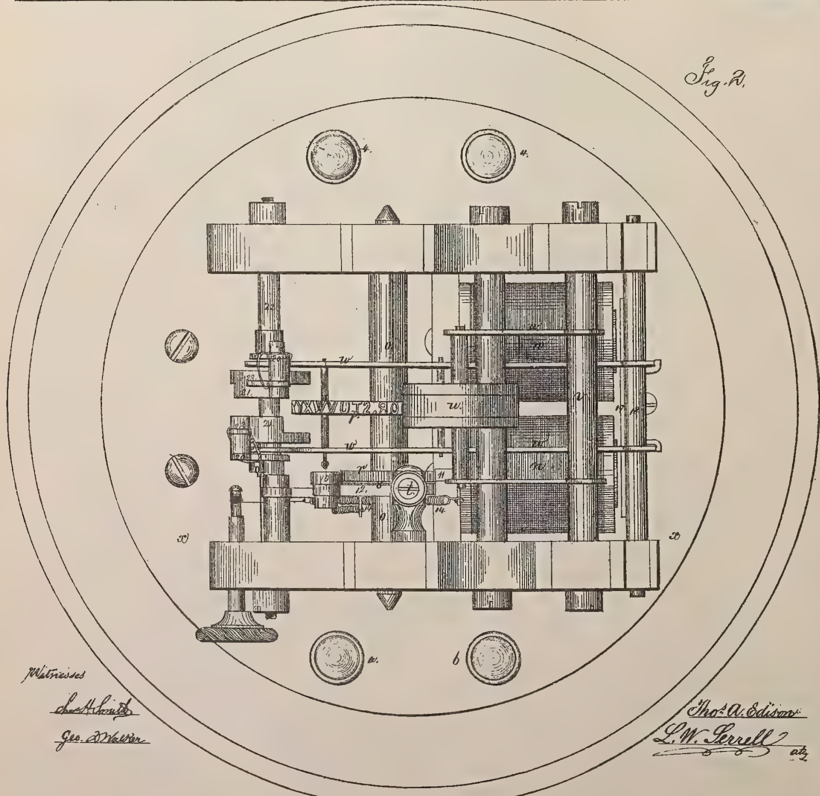


Fig. 2.

Witnesses

Chas. H. Smith

Geo. D. Walker

Thos. A. Edison

L. W. Serrell atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **113,033,** dated March 28, 1871.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made a new and useful Improvement in Telegraph Apparatus, and the following is declared to be a correct description of the same:

The object of this invention is to operate a local circuit, and one of two electro-magnets therein, from a distant station, over one wire, by means of pulsations of one polarity operating one electro-magnet in the said local circuit, and pulsations of the opposite polarity operating the other electro-magnet in the said local circuit. Several stations on one line, each having its own local circuit, can be operated in unison, and I apply to the said magnets means for actuating a type-wheel and a printing-lever at the proper times by reversing the polarity of the current, and I arrange the type-wheel characters in such a manner that the printing of fractions in the quotations of gold, stocks, or market-prices is greatly facilitated.

My present invention relates especially to a polarized bar or switch that, in a normal condition, is maintained in a central position between two circuit-closers by the action of a spring, or its equivalent, and adjacent to this polarized bar or switch are the coils and cores of an electro-magnet, one on each side thereof, so that when pulsations of one polarity are sent through the helices the polarized bar or switch is attracted to one side, and makes and breaks each pulsation the circuit of a local battery, and thereby actuates one electro-magnet, and when the pulsations in the first-named electro-magnet are of a different polarity the polarized bar or switch works on the other side to make and break the local circuit through a second magnet arranged in that local circuit.

In the drawing, Figure 1 is an inverted plan of my telegraph-instrument. Fig. 2 is a plan of the same. Fig. 3 is a section at the line *x x*, and Fig. 4 is an edge view of the type-wheel separately.

The line wires are connected with the binding-screws *a b*, and from these the wires pass to the helices *c d* of the soft-iron cores forming an electro-magnet. Between these helices is the polarized bar or switch *e*, that is made so that it can swing between the poles of the electro-magnet. At one end this bar or switch is connected by a screw, (or it might be by a spring-tongue,) and the other end, in its normal condition, is midway between the poles 2 2 of the electro-magnet *c d*, and also between the circuit-closers *g h*, and it is held in that position by the thin spring-tongue *e′*, or an equivalent yielding centering device. The local-circuit wires come from the battery to the binding-screws 4 4. The wire 5 connects the switch *e* to one of these screws 4; the circuit-closer *g*, wire 6, electro-magnet *m*, and wire 7, connect with the other battery-screw 4, so that when pulsations of one polarity pass through the electro-magnet *c d* the tongue *e* closes the local circuit through *g*, and incites the electro-magnet *m*, but when pulsations of the opposite polarity are sent the magnet *m* is not incited, but the electro-magnet *n* is rendered operative by the local circuit being connected through the screw 4, wire 5, switch *e*, circuit-closer *h*, wire 8, magnet *n*, wires 9 and 7, and binding-screw 4.

Each positive pulsation of electricity in the main line gives a pulsation in one of the magnets in the local circuit, and these pulsations can be repeated to whatever extent desired, because the switch *e* returns to a central or normal position each pulsation, and when the polarity of the main current is changed so as to be negative, then the other magnet in the local circuit will be similarly incited each pulsation in the main circuit.

By these means the local circuit at a distant station or the local circuits at more than one distant station are made to operate different magnets according to the polarity of the current sent, and hence one magnet or set of magnets in the distant local circuits or circuits will be incited to perform one operation, and afterward the other magnet or magnets to perform a different operation. I have shown these magnets *m* and *n* in connection with the printing-telegraph mechanism. The armature *l* of the magnet *m* has a forked lever, 10, upon one arm of which is a wedge-shaped tooth, 11, and upon the other arm is the pawl 12. Upon the shaft *o* of the type-wheel *p* are two ratchet-wheels, *r* and *s*. The pawl 12 acting upon the teeth of *s* gives motion to the type-wheel *p*, and its end runs under the adjustable stop *t* and blocks the parts so that the momentum will not cause the type-wheel to turn too far. The swing-

ing pawl 13 takes the teeth of s, preventing any back movement, and as the armature l recedes by the action of the spring 14 the tooth 11 takes into the teeth of the wheel r, and by the inclined wedge-acting end completes the movement of the type-wheel necessary for bringing the next character into place for printing, and holds said type-wheel firmly in place. The pawl 12 draws back to take another tooth of s as the tooth 11 comes up against r. The type-wheel is inked by the roller u that is mounted upon arms and the shaft v. The printing-lever w swings upon the shaft 18, and is actuated by the armature 19 of the magnet u and said lever w carries the printing-pad w'. The paper is fed along by clamps. The lever 20 and segment 21 move together upon the cross-bar 22, and the lever 20 carries a clamping-pawl, 23, the end of which is contiguous to the segment 21. These parts are duplicated on the other side of the strip of paper, and motion is given to one clamp to seize and carry forward the paper as the other clamp draws back, this movement being effected by slots in the ends of the printing-lever inclined in opposite directions and acting upon pins that project from the respective levers 20.

The type-wheel is made with letters and figures and a hyphen or fractional sign, so that the name of the article can be printed and the price in figures and fractions, and in quotations of market-values it is usual to reckon in eighths, quarters, or halves. I, therefore, arrange the figures that will be employed as numerators, such as 1 5 7 3, in the first portion of the line of figures, and then place a hyphen and the other figures thereafter, so that the numerators can first be impressed, then the hyphen or fractional sign, then the denominators. Thereby a saving in time is effected, because the fraction entire can be printed in less than a rotation of the type-wheel, thus: 1–8 1–4 3–8 1–2 5–8 3–4 7–8.

I am aware that in H. and E. Highton's English patent No. 12,039, a horseshoe-magnet is pivoted to swing between two electro-magnets to make and break local circuits; but this device is not adapted to a rapid movement, and acts in a different manner to my polarized bar or switch. In my apparatus the spring acts instantly to bring the switch to a central position and break the local circuit simultaneously with the break in the main circuit. I am also aware that a bar has been polarized by the main currents to act as a switch, and direct the local current to one of two magnets; but said bar was moved only by a change in the polarity of the current.

I claim as my invention—

1. A polarized bar or switch and connections acting as a relay to electro-magnets placed in a local circuit, in combination with an electro-magnet in the main line acting upon such polarized bar or switch to complete the local circuit through one of the two electro-magnets, according to the polarity of the current sent, substantially as set forth.

2. A local circuit, two electro-magnets, a type-wheel, and impression mechanism, in combination with the polarized bar or switch and electro-magnet, substantially as and for the purposes set forth.

3. A series of polarized relays worked in one main circuit and controlling local circuits that operate either type-wheel magnets or printing-magnets, substantially as set forth.

4. A polarized relay having its tongue or switch centered between the poles of an electro-magnet and between the circuit-closers when in a normal condition, substantially as set forth.

5. A type-wheel having letters, figures, and fractional signs arranged in groups for numerators and for denominators on opposite sides of a fractional sign, substantially as set forth, to print letters, figures, and fractions, as specified.

6. A type-wheel with figures arranged on each side of a hyphen or fractional sign, as and for the purposes set forth.

7. The type-wheel motor composed of a vibrating arm and pawls 12 and 13 combined with a wedge-acting tooth, in the manner and for the purposes set forth.

Signed by me this 17th day of November, A. D. 1870.

THOMAS A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

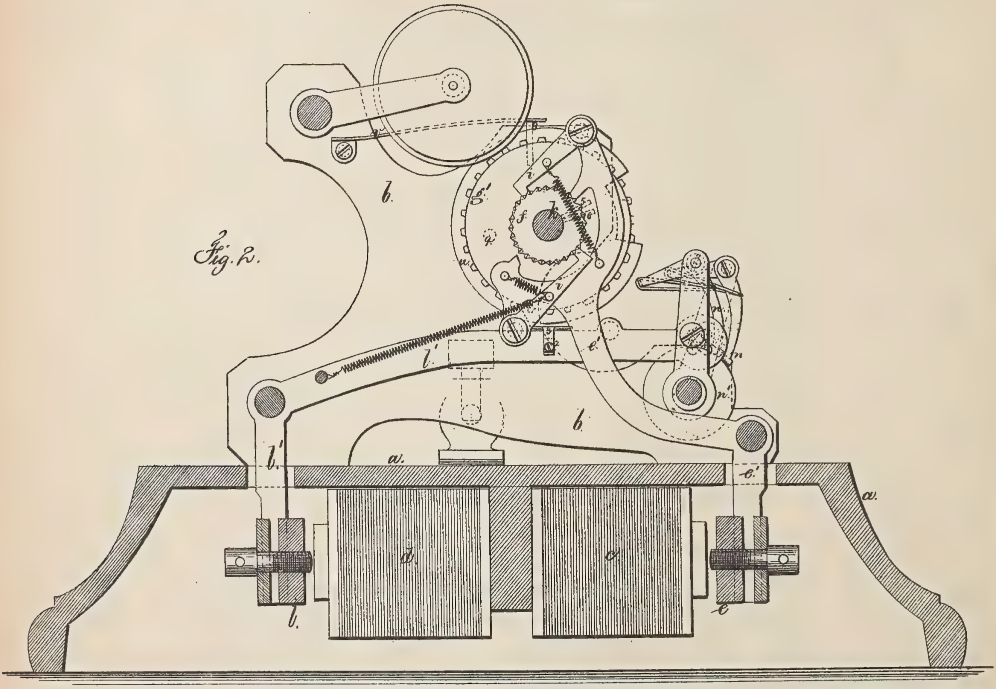
2 Sheets—Sheet 1.

T. A. EDISON.

Printing Telegraph.

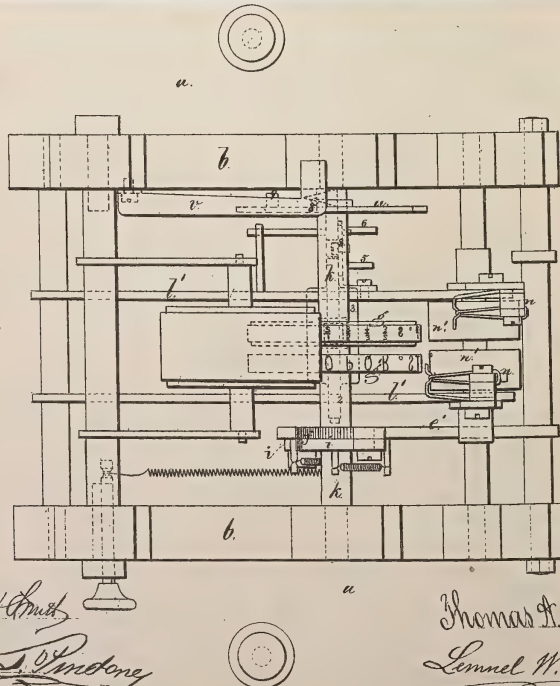
No. 113,034. Patented March 28, 1871.

Fig. 2.



a.

Fig. 1.



a

Witnesses

Chas H Smith

Geo. T. Pinckney

Thomas A. Edison

Lemuel W. Serrell Atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

2 Sheets—Sheet 2.

T. A. EDISON.

Printing Telegraph.

No. 113,034. Patented March 28, 1871.

Fig. 4.

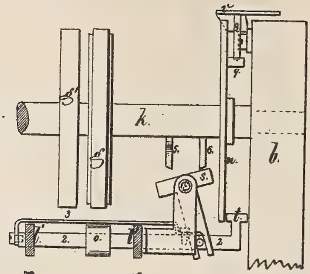


Fig. 3.

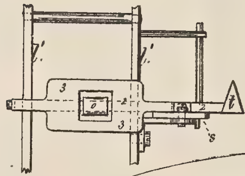
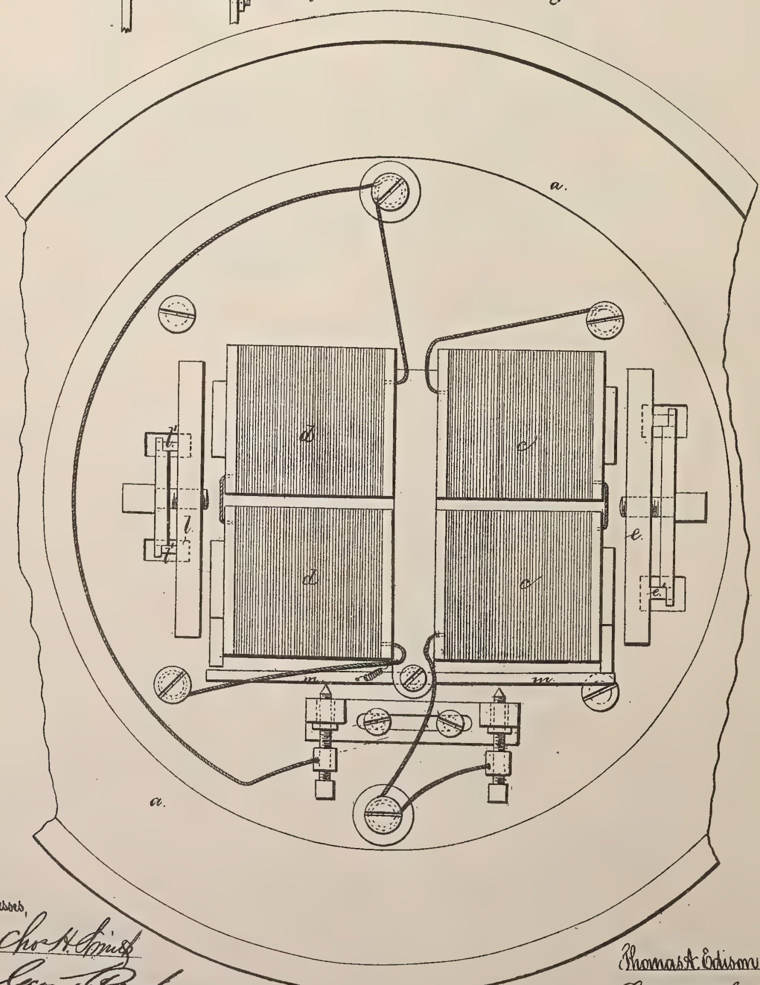


Fig. 5



Witnesses,

Chas. H. Smith

Geo. T. Pinckney

Thomas A. Edison.

Lemuel W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. 113,034, *dated March* 28, 1871.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, and the following is declared to be a correct description thereof.

This invention is made for printing from one of two type-wheels at pleasure, by changing the printing-pad from the line of one wheel to that of the other.

By this means a printing-telegraph or a number of instruments in one circuit can be worked with one wire, and the impressions be taken from either the letter-wheel or the figure-wheel, and the impression given by reversing the circuit.

If, therefore, the telegraph is required for printing letters, the same can be done without the loss of time incident to passing over figures, as in the type-wheels that contain both letters and figures; and when figures or fractions are to be printed, that can be done regardless of the contiguous wheel containing letters.

The pressure-pad is shifted in the impression-lever by a movement derived from the motion of the printing-lever at the time the blank spaces of the type-wheels are contiguous to the pad.

In the drawing, Figure 1 is a plan of the machine. Fig. 2 is a sectional elevation. Fig. 3 is a detached plan of the printing-pad. Fig. 4 is a detached elevation of the type-wheels and pad-shifting device. Fig. 5 is an inverted plan of the machine.

The bed *a* is provided with frames *b*, that carry the mechanism, and within the bed *a* are the electro-magnets *c* and *d*.

The magnet *c* acts upon the amature *e* to give motion to the lever *e'*, pawls *i*, ratchet-wheels *f*, shaft *k*, and type-wheels *g*, *g'*, and *h*; and the magnet *d* acts upon the armature *l* of the printing-lever *l'*.

The polarized switch *m* directs the current through either the magnet *c* or the magnet *d*, according to the polarity of that current, and these magnets and connections, being substantially similar to devices heretofore secured to me, (see Patent No. 4,166, reissue,) need not be herein described.

The printing-lever *l'*, paper-feeding clamps *n*, and rollers *n'* are similar to the lever and its connections shown in my Patent No. 4,166, except in the devices next described.

The impression-pad *o* is mounted upon a slide, 2, that passes across the lever *l'* and beneath the type-wheels, and a small shield, 3, is attached to this slide, and has an opening above the pad *o*, so as to interpose between the paper and the type-wheel, except directly over the pad *o*.

Near one end of the slide 2 is an arm upon the printing-lever, carrying the fulcrum of the shifting-dog *s*, that is made of a T shape, the lower end being slotted and taking a pin that projects from the slide 2; and upon the type-wheel shaft *k* are two figures, 5 and 6, that are so placed relatively to the blank spaces of the type-wheel that the figure 5 comes over one end of the dog *s* as one blank space of the type-wheel comes over the pad; hence, if the impression-lever is moved at this time, the pad will be shifted by the dog *s* being pressed up against the finger 5, and if the type-wheel is moved another notch the finger 5 passes beyond the dog *s*, and the figure 6 comes over the other arm of said dog, and in this position the pad will be shifted the other way by the movement of the printing-lever.

It is now to be understood that when the printing-pad is beneath the number-wheel *g* the impression will be made from the same, and there will be no impression from the other or figure-wheel, and vice versa; hence, either wheel can be made use of for an indefinite period, the same as any ordinary printing-telegraph; and when it is desired to bring the other type-wheel into action it is only necessary to turn the type-wheel around until the finger 5 or 6 is brought over the elevated arm of the dog *s*, and then reverse the electrical current to move the impression-lever, which gives a motion to change the impression-pad laterally and bring it under the other type-wheel *g'* or *g*, and then the type-wheels can be moved around to bring the proper letter of the letter-wheel or figure of the figure-wheel into position for impression, so that, although two types are in position, an impression only is taken from the one beneath which is the pad *o*.

In order to prevent any risk of the pad *o*

shifting by the vibration of the parts, I provide an inclined holder, *t*, on the end of the slide 2, and a disk, *u*, upon the shaft *k*.

This disk is notched at one side to allow the pad to be shifted either way, and when the type-wheel is revolved the disk *u* passes either one side or the other of the holder *t*, and, if the pad *o* and its slide has not been fully moved either one way or the other, this disk completes that movement by acting against the incline of the holder *t*.

The transmitting instrument may be a dial and revolving arm with two blank spaces, one denoting the point at which to stop and move the printing-lever to change from letters to figures, and the other to change from figures to letters.

A spring, *v*, with a pin, 8, may be employed to take against a pin, 9, on the disk *u*, to afford an indication, when depressed, of the place at which to stop in changing the instrument. Said pin also answers for bringing the instrument into unison where there are several in the same line. This unison stop-lever will be operated by the attendant at each station when it becomes necessary to set his instrument, by preventing the movement of the type-wheel until the wheel at the transmitting-station is brought to the same zero-point.

I claim as my invention—

1. A shield, with an opening adjacent to the pressure-pad and moving with the same, in combination with two contiguous type or character wheels and mechanism for actuating the same in a printing-telegraph instrument, substantially as set forth.

2. A movable pressure-pad, mounted upon the printing-lever, and two contiguous type-wheels on one shaft, in combination with two electro-magnets and armature, and a circuit-changer, substantially as set forth, whereby the type-wheels are set by one electro-magnet, and the pressure-pad is either changed in position or the printing effected by reversing the polarity of the electrical current, substantially as set forth.

3. The movable pad, mounted upon a transverse slide in the impression-lever, in combination with the shifting-dog *s*, and fingers 5 and 6 upon the type-wheel shaft, substantially as set forth.

4. The notched disk *u* and inclined holder *t*, in combination with the shifting-pad *o*, substantially as and for the purposes set forth.

5. The unison-stop lever *v*, in combination with the shifting-pad and two contiguous type-wheels, substantially as set forth.

Signed by me this 10th day of January, A. D. 1871.

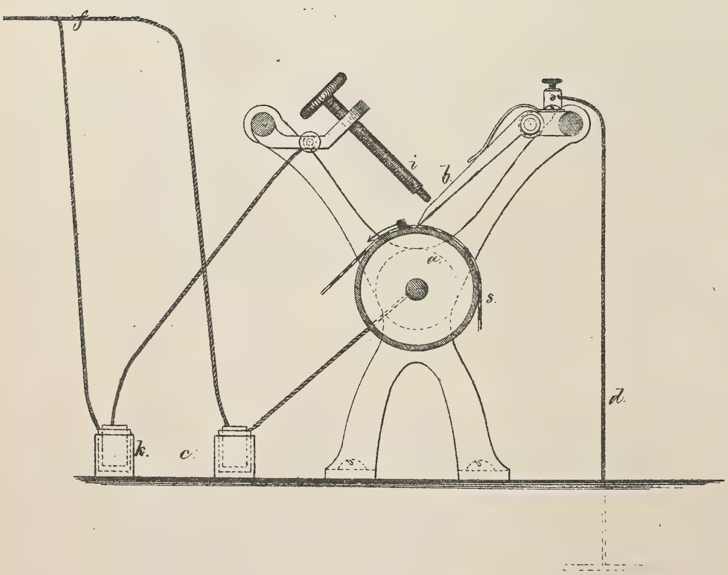
THOMAS A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

THOMAS A. EDISON.

Improvement in Telegraphic Transmitting Instruments.

No. 114,656. Patented May 9, 1871.



Witnesses,

Chas. H. Smith

Geo. D. Walker

Thomas A. Edison

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN TELEGRAPHIC TRANSMITTING-INSTRUMENTS.

Specification forming part of Letters Patent No. **114,656**, dated May 9, 1871.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improved Telegraphic Transmitting-Instrument; and the following is declared to be a correct description of the said invention.

In telegraphing, a perforated strip of paper has been employed to make and break the electrical circuit in trasmitting the message. In transmitting-instruments adapted to said paper there is a small disk or wire brush that closes the metallic circuit through the perforations, and the circuit is broken by the paper when the unperforated portion intervenes between the roller or plate and the disk or wire brush.

The transmission of pulsations of electricity being very rapid in this system of telegraphing, there is a difficulty that sometimes arises from the wire not clearing itself, and the pulsations are attenuated and do not distinctly reach the distant station.

My invention consists in arranging the connections and portions of the instrument in such a manner that a reverse current shall be thrown upon the wire of the circuit by a motion derived from the thickness of the paper when the same is drawn in between the plate or roller and the brush or disk.

In the drawing, the device in question is represented by a side view.

Let *a* represent a plate, roller, or metallic surface, over which the strip of perforated paper *s* is drawn, and *b* represent a wire brush, stilus, or roller, these parts being of any known character, for sending pulsations of electricity to a distant receiving-instrument. The battery is represented at *c*, and the ground-wire at *d* and the line-wire at *f*. The current will therefore be sent, when the circuit is closed, through the perforation of the paper; and when the unperforated portion of the paper is beneath the brush or stilus *b* the end is lifted sufficiently to touch, or nearly so, the point *i*, that is adjustable and mounted in any convenient manner. By the said movement the battery *k* is brought into action by closing the circuit between *i* and *b*, and a reverse current is thrown upon the telegraph-line, thereby preventing the attenuation of the previous pulsation, clearing the wire, and causing the mark at the receiving-station to be clear and distinct.

I claim as my invention—

A circuit-closer operated by the movement of the perforated paper in a telegraph transmitting-instrument to throw a reverse circuit on the line, substantially as set forth.

Signed by me this 22d day of June, A. D. 1870.

THOMAS A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

THOMAS A. EDISON.

Improvement in Relay Magnets for Telegraph-Instruments.

No. 114,657. Patented May 9, 1871.

Fig. 1.

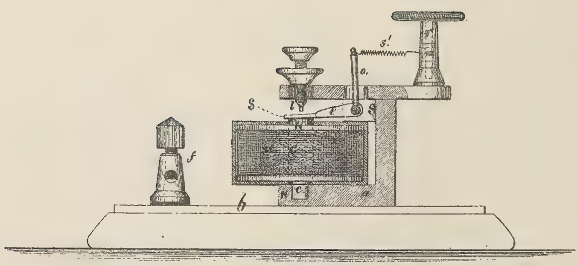
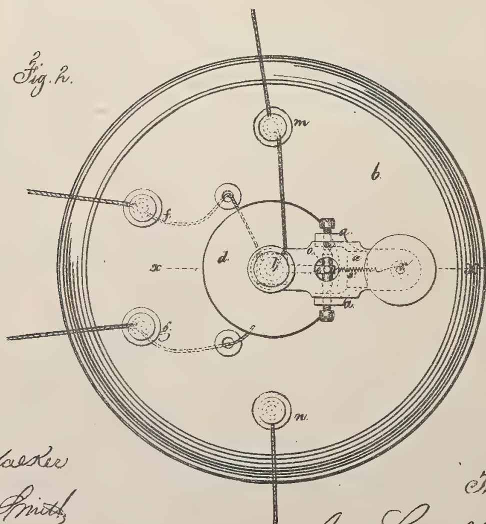


Fig. 2.



Witnesses.

Geo. D. Walker

Chas. H. Smith

Thos. A. Edison

per Lemuel W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND MARSHALL LEFFERTS, OF NEW YORK CITY.

IMPROVEMENT IN RELAY-MAGNETS FOR TELEGRAPH-INSTRUMENTS.

Specification forming part of Letters Patent No. **114,657**, dated May 9, 1871.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Electro-Magnets; and the following is declared to be a correct description thereof.

The object of this invention is to produce an electro-magnet that can be operated with great rapidity and accuracy, and capable of being used as a relay or repeater for a chemical telegraph operated by punched paper and a stilus or brush circuit-closer, or for a time-repeater in astronomical or other observatories, or for a relay or repeater to a Morse telegraph-instrument, or wherever great rapidity or accuracy of movement is required.

I make use of a soft-iron core to a short single-spool electro-magnet, and this is mounted upon one end of a permanent magnet, and the other end of said permanent magnet is near the core of the electro-magnet, and has a small hinged tongue, so that the tongue is attracted to the core by the polarity due to the induced magnetism of that core and tongue, and the coils of the helix are so wound as to make the core, by a pulsation, an electro-magnet of an opposite polarity to what it was by the induced magnetism.

The attraction from the induced magnetism is almost counterbalanced by a spring; hence the slightest current of electricity that will neutralize the induced magnetism will produce a motion of the tongue and close or break a secondary local relay, or other electrical circuit; and the core being very short and the connections direct, the magnet frees itself rapidly and can be operated by the most minute pulsation.

In the drawing, Figure 1 is a vertical section of the instrument at the line *x x* of Fig. 2, which is a plan of said instrument.

The permanent magnet *a* is sustained upon the bed *b*, and is magnetized so that one end of it is a north polarity and the other south. They are marked N. S.

Upon the pole N of the permanent magnet *a* is a soft-iron core, *c*, surrounded by a helix, *d*, and this helix is wound in such a manner and so connected to the insulated binding-screws *f g* that the pulsation of electricity will make the soft-iron core *c* of a different polarity from what it is by the induced current, so that if the core *c* is upon the north pole of *a*, then the induced current will make the core *c* a magnet of northern polarity, and the pulsation of electricity in the helix will neutralize that induced magnetism, making or tending to make the soft-iron core an electro-magnet of southern polarity.

At the end *s* of the magnet *a* a small iron tongue, *e*, is hinged, so as to vibrate with the moving end over the core *c*, and to this tongue a spring is applied and made adjustable in any suitable manner.

I have shown the arm *o*, spring *s'*, and adjusting-rod *r*, and the power of the spring is adjusted so as not to be sufficient to raise the tongue *e*, the attraction between *e* and *c* from induced magnetism being just sufficient to keep the parts *e* and *c* in contact.

Above the tongue *e* is an adjustable circuit-closer, *l*, that is insulated and connected to the binding-screw *m;* and the tongue *e* is connected, through the magnet *a* and base *b*, with the other binding-screw *m*.

A primary circuit is connected with the binders *f* and *g*, and, where a local or secondary circuit or relay is operated by this device, the wires thereof are connected to *m* and *n*, and the said local or secondary circuit is closed by the rising of the tongue *e*, when the pulsation through *f*, *g*, and *d* sufficiently neutralizes the induced magnetism in *c* and *e* to allow the spring to separate them.

In consequence of using a short single helix, with short connections and a short tongue, having but a small movement, there is nothing to interfere with the movement being very rapid; and, the circuit-closer of the local or secondary circuit being immediately over the electro-magnet, there is no loss of time or motion in making the connections of the secondary circuit.

The electro-magnet operates to repel the tongue *e* at the time the tongue is in contact; hence, there being no intervening space, the magnetic action is more instantaneous than it would be if a space intervened, as with an ordinary armature.

In consequence of the features aforesaid, all

acting to promote rapidity of action, this electro-magnet is capable of repeating with a secondary or relay circuit the pulsations given by punched paper drawn through a transmitting-machine at ordinary rate, and to properly proportion the dots, dashes, and spaces; and this speed and accuracy of movement are available for other purposes in electrical appliances.

I do not claim a magnet with a single helix and core; neither do I claim a polarized magnet in which a permanent magnet and tongue are employed. I have discovered that, in order to obtain a rapid electro-magnet that is adapted to a relay or repeater in automatic telegraphs, the vibrating tongue must, in a normal position, remain in contact with the core by induced magnetism and be repelled by the electro-magnetism, or else the space intervening between the core and tongue will interfere with the rapidity of action; and the electro-magnet must not be more than an inch in length to free itself of the electrical pulsation with sufficient rapidity; and, the tongue swinging upon an axis at right angles to the core of the electro-magnet, the said tongue will vibrate in the line of the magnetic action, and more rapidly than the polarized magnets, in which the tongue swings on an axis parallel to the core of the electro-magnet.

I claim as my invention—

1. A permanent magnet, an electro-magnet, and a vibrating tongue, arranged substantially as set forth, so that the tongue will be repelled from its contact with the core of the electro-magnet by the electric pulsation, substantially as specified.

2. An electro-magnet of less than an inch in length, with a permanent magnet and swinging tongue to make and break the circuit in an automatic telegraph, substantially as and for the purposes set forth.

3. The electro-magnet, permanent magnet, and a tongue that swings toward and from the end of the core of the electro-magnet upon an axis at right angles to such core, as and for the purposes set forth.

Dated September 6, 1870.

T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

Electro Magnets for Telegraph Instruments.

No. 114,658. Patented May 9, 1871.

Fig. 2

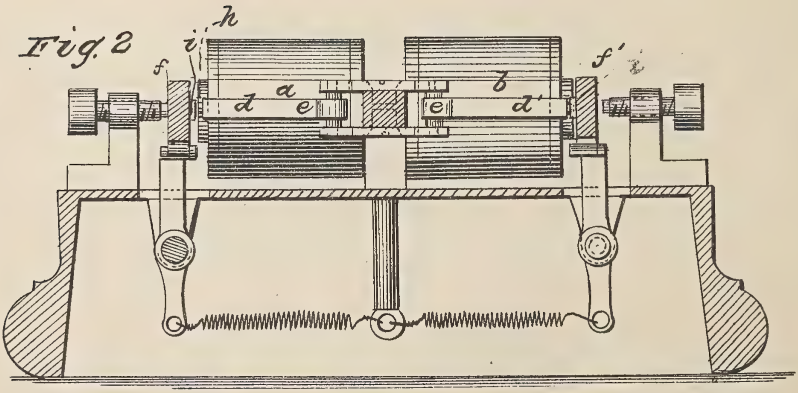
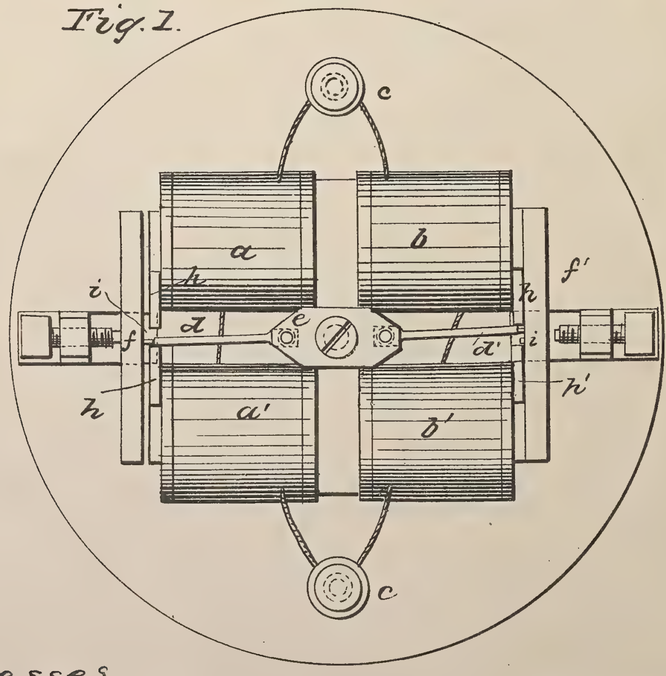


Fig. 1.



Witnesses

Chas H Smith

Geo D Walker.

Inventor.

Thomas A. Edison

N. PETERS, Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND MARSHALL LEFFERTS, OF NEW YORK CITY.

Letters Patent No. 114,658, dated May 9, 1871.

IMPROVEMENT IN ELECTRO-MAGNETS FOR TELEGRAPH INSTRUMENTS.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made a new and useful Improvement in Electro-Magnets for Telegraphs, &c.; and the following is hereby declared to be a correct description thereof.

This improvement relates to a means for rendering an electro-magnet inoperative when a current of one polarity is used, and operative when a current of the opposite polarity is employed so that two different operations may be performed in a telegraph or other machine with only one wire.

The invention consists in a blocking-finger or stop, that prevents the movement of the armature, said stop being operated according to the polarity of the electro-magnet.

In the drawing—

Figure 1 is a plan of a double magnet, and

Figure 2 is a vertical section.

The magnets *a a′* and *b b′* are of any ordinary or desired construction, and are connected with the line-wires of a telegraph or the electrical circuit in any usual manner, *c c* representing the binding-screws, and the connections are substantially as shown, so that the pulsations of electricity pass through the magnet or magnets.

Between the poles of the magnet a finger, *d*, is fitted to swing on the fulcrum *e*, and the end is continuous to the armature *f*, and there is a block or equivalent device, as at *i*, so that when the finger *d* is swung toward the pole *a* the armature *f* will be free to vibrate; but when said finger *d* is swung toward the pole *a′* the armature will be locked, so that it cannot vibrate.

The locking action may be of the character shown, so that the armature may be kept away from the magnets, or in the form of a hook, to keep the armature toward the magnet.

The electro-magnets are provided with the lateral arms *h h′*, and these become polarized, according to the positive or negative polarity of the current; hence the finger *d* is attracted or repelled, and swung to one side to block the armature, or to the other side to release the same.

This construction may be availed of to render operative or inoperative one electro-magnet in any machinery. I, however, have represented a double magnet constructed and connected so that one armature, *f′*, can be locked and rendered inoperative by the finger *d′*, while the armature *f* is operative, in consequence of the finger *d* being swung out of action, and *vice versa*, the operations being reversed by changing the polarity of the currents, the pulsations always going through the magnets; and in these particulars this present invention is to be distinguished from those heretofore made by me, in which the polarity of the current operates devices that divert the current from one magnetic coil into another.

I claim as my invention—

1. A finger or stop operated by electro-magnetism, and arranged so as to block or release the armature according to the polarity of the electrical current passing through the magnet, substantially as specified.

2. The double electro-magnet, armatures, and stops, arranged substantially as specified, so that a current of one polarity shall allow one armature to vibrate and block the other, and the reverse, as set forth.

Signed by me this 22d day of June, A. D. 1870.

THOMAS A. EDISON.

Witnesses:

CHAS. H. SMITH,
GEO. T. PINCKNEY.

(50.) 3 Sheets--Sheet 1.

THOMAS A. EDISON.

Machinery for Perforating Paper for Telegraphic Purposes.

No. 121,601. Patented Dec. 5, 1871.

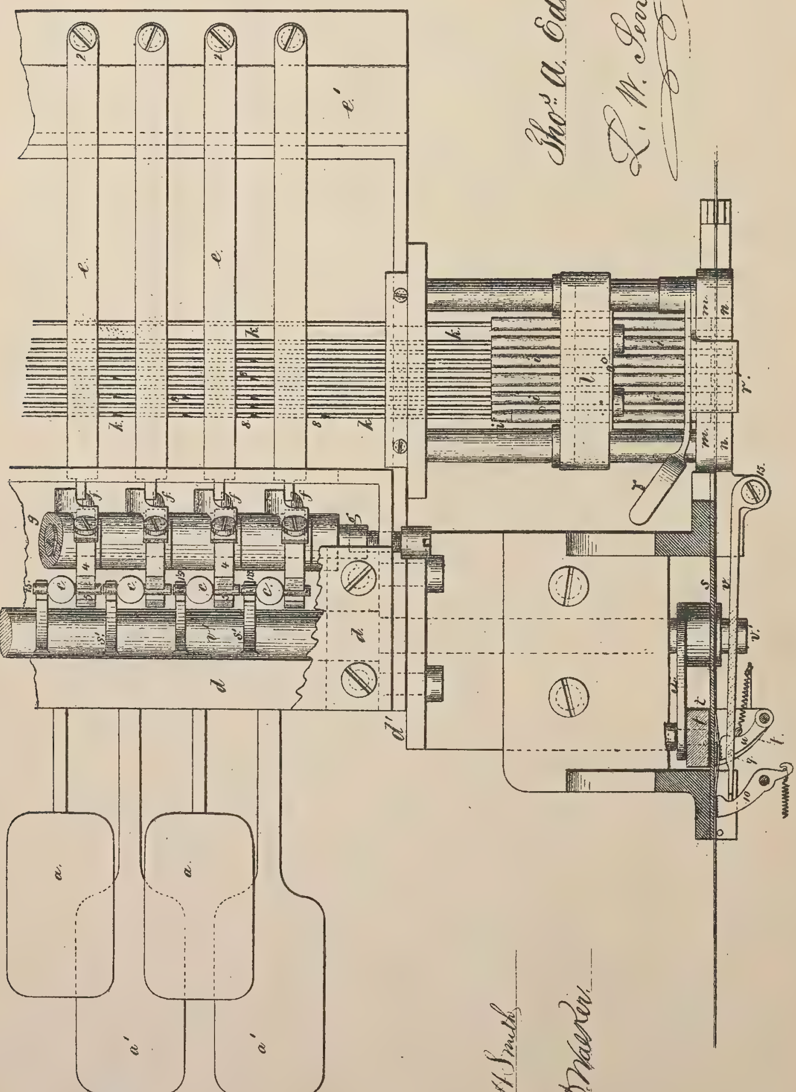


Fig. 1.

Witnesses.

Chas. H. Smith

Geo. D. Walker

Thos. A. Edison

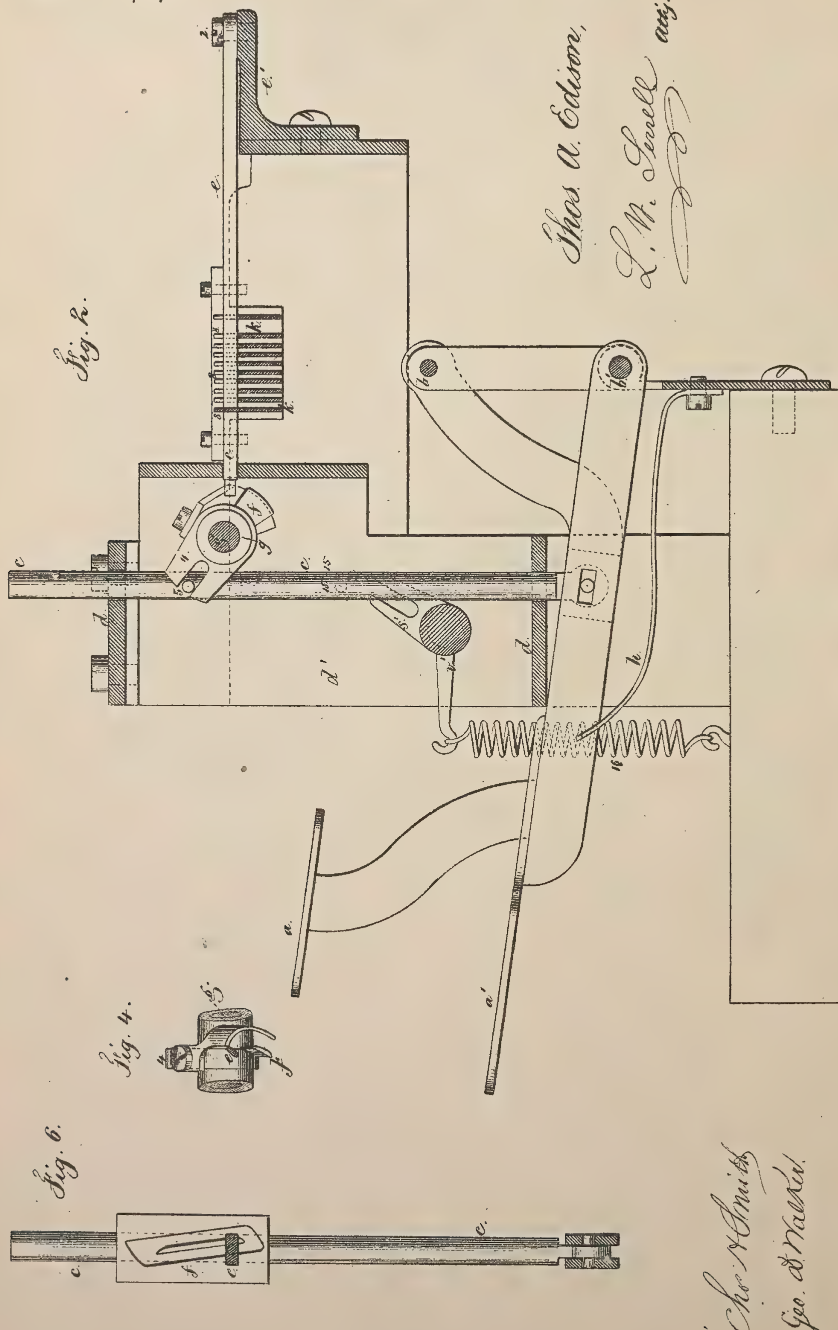
L. W. Serrell att'y

(50.) 3 Sheets--Sheet 2.

THOMAS A. EDISON.

Machinery for Perforating Paper for Telegraphic Purposes.

No. 121,601. Patented Dec. 5, 1871.



Thos. A. Edison, by L. W. Serrell, atty.

Witnesses, Chas. H. Smith, Geo. D. Walker.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

(50.)

3 Sheets--Sheet 3.

THOMAS A. EDISON.

Machinery for Perforating Paper for Telegraphic Purposes.

No. 121,601. Patented Dec. 5, 1871.

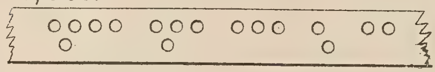


Fig. 3.

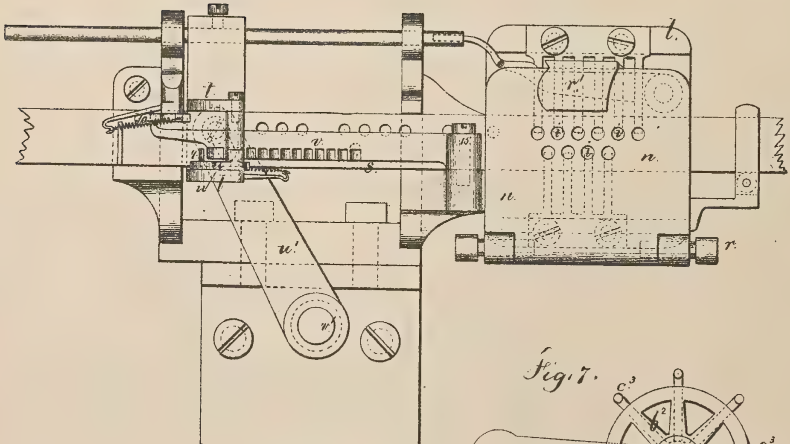


Fig. 7.

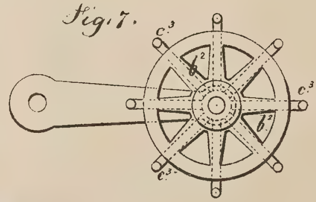
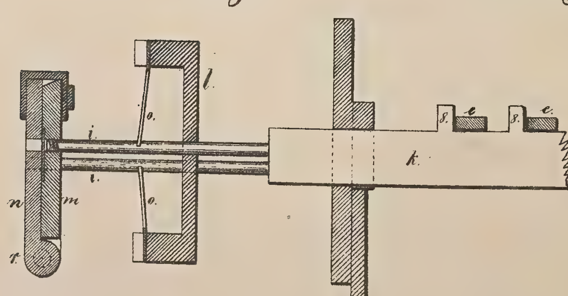


Fig. 5.



Witnesses,

Chas. H. Smith

Geo. D. Walker

Thos. A. Edison,

L. W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN MACHINERY FOR PERFORATING PAPER FOR TELEGRAPHIC PURPOSES.

Specification forming part of Letters Patent No. 121,601, dated December 5, 1871.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Perforating-Machinery for Telegraphic Purposes; and the following is declared to be a correct description thereof.

This machinery is for perforating strips of paper employed in transmitting telegraphic messages, the perforations in the paper allowing the circuit to be closed, as heretofore well known. A range of finger-keys is provided, and also a range of slide-plates operating upon punches. A presser-lever is connected by a cam with each finger-key, and contiguous thereto are projections upon such of the slide-plates as are to be actuated by the said finger-key; thereby on striking the finger-key the proper punches are actuated to punch the perforations necessary for the letter complete; and on releasing the finger-key the paper is drawn along the proper distance by a peculiar feeding mechanism, and the perforations are made in two lines, so that where three or more perforations are placed triangularly a long pulsation may result from the metallic connection being made through those perforations successively, the contact being made through the second perforation before ceasing through the first, and so on.

In the drawing, Figure 1 is a plan of a portion of the instrument with the paper-feed in section. Fig. 2 is a vertical section at the finger-keys. Fig. 3 is an elevation of the paper-feed and dies. Fig. 4 is a separate view of the cam that actuates the presser-lever. Fig. 5 is a cross-section of the punches and dies, and Fig. 6 is a modification of the device that connects the finger-key and presser.

The finger-keys *a a* are mounted upon a fulcrum-shaft, *b*, and the second range of keys *a′* swing on the shaft b^1, this arrangement facilitating the construction and allowing the keys to be arranged compactly, and at the same time they are convenient for fingering. The vertical bars *c c* slide in supports *d*, and are jointed at their lower ends to the keys *a a′*, or otherwise connected. These supports *d* form part of a frame, with end pieces *d′* that inclose the key-levers and connected parts, and also sustain the shaft *v′* that is employed for actuating the paper-feed, the paper and mechanism that act upon the same being outside the end piece *d′* of said frame. The presser-levers *e e* are connected by screws or pins 2 on the frame or bar *e′* so as to swing horizontally, and are each actuated by a cam, *f*, upon the bar *c*, as in Fig. 6; or by a swinging cam upon a sleeve surrounding the stationary bar *g*, as shown in Figs. 1, 2, and 4; said swinging cams being provided with jaws 4, in which the pins 5 of the bars *c* slide as the latter are depressed by the finger-key. These cams *f* are shaped so as to give a definite movement to the levers *e* and slide-plates *k* sufficient to operate the punches, and then the levers *e* are relieved to allow the springs of the punches to throw them back out of the paper, the presser *e* and punch or punches being operated as the key is depressed, and as the key is relieved the movement of the cam *f* in the other direction insures the drawing back of the presser-lever *e*. Each finger-key is raised by a spring, *h*, and there are to be as many finger-keys and parts operated by each as there are letters or separate characters employed in telegraphing. Beneath these pressers *e* are the slide-plates *k k*, corresponding in number to the punches employed. The punches *i i* are round steel rods sliding in the heads *l m* and acting against the dies *n* to punch the paper that is introduced between *m* and *n*, and the rear ends of these punches should be made smaller, as shown at *i′*, in order that there may be room for the ends of the slide-plates *k* to pass between the adjacent punches and only act upon its own punch. The ranges of springs *o* enter notches in the punches *i* and throw the punches back, and the punches are positioned in two lines, as seen in Fig. 5, the distance between the punches being less than the diameter of the punch, and the punches of the upper range are above the spaces between the lower punches; thereby, if three contiguous punches are simultaneously actuated, the perforations will be equivalent to a dash, and cause a long pulsation from the transmitting instrument and produce a dash at the receiving instrument. Upon the slide-plates *k* are projections 8, contiguous to the pressers *e*, and these projections 8 are to be upon only such of the slide-plates as are required to be moved by the presser to which they are contiguous, so that only those slides will be moved upon depressing a finger-key that operates the punch or punches that make the perforations for the corresponding character; hence

the necessary perforations can be made in the strip of paper for composing the message by dots and dashes, the dashes at the receiving station being of any desired length, according to the number of consecutive perforations in the two lines of perforations made in the paper.

By this arrangement any desired character of alphabet or code of signs can be adopted within the scope of the instrument; and I remark that the number of punches may be increased at pleasure, and also the number of finger-keys.

By boring the holes in *l m n* for the punches all at the same time they will all be properly in line with each other, and the punches *i*, being round parallel wires notched for the ends of the springs, are easily made or replaced. The cutting end of each punch is to be a conical or concave hole, and the sharpening is to be effected by deepening this hole by a proper tool. These punches will cut the paper with less power and more reliably than the flat-ended punches heretofore used.

The parts *m n* are to be hinged together at *r* to allow the die-plate *n* to be swung open in removing any obstruction. The clip *r′* holds the die in place when shut. The paper-carrier *t* is moved back toward the punches *i* each time a finger-key is depressed, and during the time that the paper is being punched and the feed takes place as the key rises. The backward movement is to be the distance required for the character that is simultaneously punched. The mechanism for giving this motion may be of any suitable kind. The device which I employ for this purpose is next described.

A rack-bar, *v*, swinging upon the screw 15, is provided, and in the lower edge are inclined or cam-shaped teeth, and upon the carrier *t* is a pawl, *u*, with an inclined finger, 9; hence as the carrier *t* is moved back the pawl *u* is lifted from the paper by finger 9 turning upon the teeth of the rack-bar *v*, and the carrier and pawl can be moved back any required distance and the paper remain unacted upon, and is held by the spring-pawl 10; but as soon as the carrier *t* commences to move in the other direction the inclined finger 9 slips into the first opening between the inclined teeth of the rack-bar, allowing the end of the pawl *u* to approach the paper and clamp it against a thin carrier-plate on *t* that is in front of the fence *s*, and as the carrier *t* moves along the paper is drawn through between *m* and *n* until the carrier *t* reaches its extreme movement and the finger 9 clears the last tooth on the rack-bar *v*. During this movement the pawl 10 has been entirely raised from the paper by the end of the rack-bar *v* acting thereon while the finger 9 has traveled between said rack-bar and the paper. It will be thus seen that the paper is very firmly held while being moved, and that there is nothing that is moving in contact therewith and tending to injure the paper as the carrier draws back, and that the feeding motion can be to any desired extent. The motion given to the sliding carrier is shown as derived from the rock-shaft *v′* and arm *u′*. Upon the rock-shaft *v′* are forked cams *s′*, contiguous to the slide-bars *c*. The pins 15 on the slide-bars *c* enter the fork as the keys are depressed and give the required motion to the rock-shaft to move the sliding carrier back. The spring 16 acts to move the paper forward as the key rises. By positioning the pin 15 higher up or lower down it will be brought into action later or sooner in the movement of the key, and hence move the carrier *t* to a greater or less distance, and the amount that is required for the character or letter perforated by the depression of that key.

It will be apparent that when a key is struck the appropriate punches will be operated and instantly retracted, and that simultaneously the carrier and paper-feeding mechanism will be thrown back without acting on the paper. The inertia of the parts will carry the slide *t* slightly further back, and the spring *u* brings it forward before the key is relieved sufficiently for the finger 9 to enter between the teeth of the rack-bar and place the parts ready to move the paper as the key is liberated. The movement given to the paper-feed is fourfold: First, it is relieved; second, it draws back clear of the paper; third, it comes upon the paper and clamps it; and fourth, it moves with the paper. The paper is drawn along suddenly as the feed takes place; hence the paper-reel is suddenly moved and the paper thrown off the reel in a bow or loop. I construct my roller so as to prevent this occurrence. The reel b^2, Fig. 7, is made in the usual manner and mounted upon a vertical axis, and around the base of the reel I provide vertical projecting pins c^3, close to but not touching the said base of the reel, so that upon the sudden rotation of the reel the paper coil will be thrown out but cannot pass beyond these pins; thereby the paper will be held in place, and will draw off easily to the perforating-machine, as required.

The transmitting-machine is to be provided with a wire or spring brush to close the circuit through the perforations; and if the end of this brush were diagonal the long pulsation would be produced from the two lines of perforations even if the perforations were nearly in line transversely of the strip of paper.

I claim as my invention—

1. Two ranges of punches for perforating telegraphic paper with holes representing dashes, or dashes and dots, substantially as set forth.

2. A strip of telegraphic paper perforated in two lines, with the perforations arranged so that the long pulsation in transmitting is obtained from perforations in both lines, substantially as set forth.

3. A series of perforating-punches arranged in two or more lines and supported in heads that are perforated in the line of the opening in the die, substantially as set forth.

4. The die-plate *n*, hinged so as to be opened, in combination with the punches, for the purposes set forth.

5. The springs *o* combined with the punches *i*, and arranged in the manner specified to retract the punches from the die-plate *n*, as set forth.

6. The combination of the sliding punches and sliding plates k with the actuating-levers e, substantially as set forth.

7. The punches i reduced at the end next the slide-plates k, for the purposes set forth.

8. The finger-keys a a', in combination with the bars c, slide-plates k, and levers e, substantially as and for the purposes set forth.

9. Mechanism actuated by one movement of a key, substantially as specified, for punching in two rows telegraphic characters consisting of dots and dashes.

10. The finger-keys, cam-rods, levers, and cams arranged between the frames d', in combination with the punching and feeding mechanism operating upon the strip of paper running parallel or so with the finger-keys, as set forth.

11. The paper-feeding mechanism having a reciprocating movement of varying length, according to the character perforated, and acting to grasp the paper and carry the same forward, but not to catch or hold such paper on the return movement, substantially as set forth.

12. The paper-feeding clamp t moving upon the slide s, in combination with the pawl u and mechanism for reciprocating such clamp, substantially as set forth.

13. The rack-bar v with inclined teeth, in combination with the pawl u and finger 9, substantially as and for the purposes set forth.

14. The holding-pawl 10 operated by the rack-bar v, substantially as set forth.

15. The clamp t, pawl u, and fence s, in combination with the rack-bar v and pawl 10, substantially as set forth.

16. A reciprocating paper-feed in which the clamping device is lifted off the strip of paper on the backward movement and pressed upon the same on the forward movement, substantially as set forth.

17. The combination of a reciprocating paper-feed with finger-keys that operate the punches, and with mechanism connecting the said finger-keys to the paper-feed in such a manner that the movement given to the paper will be the amount required for the letter or character perforated, substantially as set forth.

18. The slide-rods c, pins 15, and cam-fork s', in combination with the rock-shaft v' and reciprocating paper-feed, substantially as set forth, for varying the feed according to the position of the pins 15 or their equivalents.

19. In an instrument for punching paper for telegraphic purposes, a series of cams each adapted to operating the mechanism that moves the punches and then releasing such punches during the downward movement of the key, substantially as set forth, so that said punches may be out of the paper before the feed takes place.

20. The paper-reel in combination with the surrounding stationary pins contiguous to the base of the reel, for the purposes set forth.

Signed by me this 16th day of August, A. D. 1871.

T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
HAROLD SERRELL.

(109)

1972

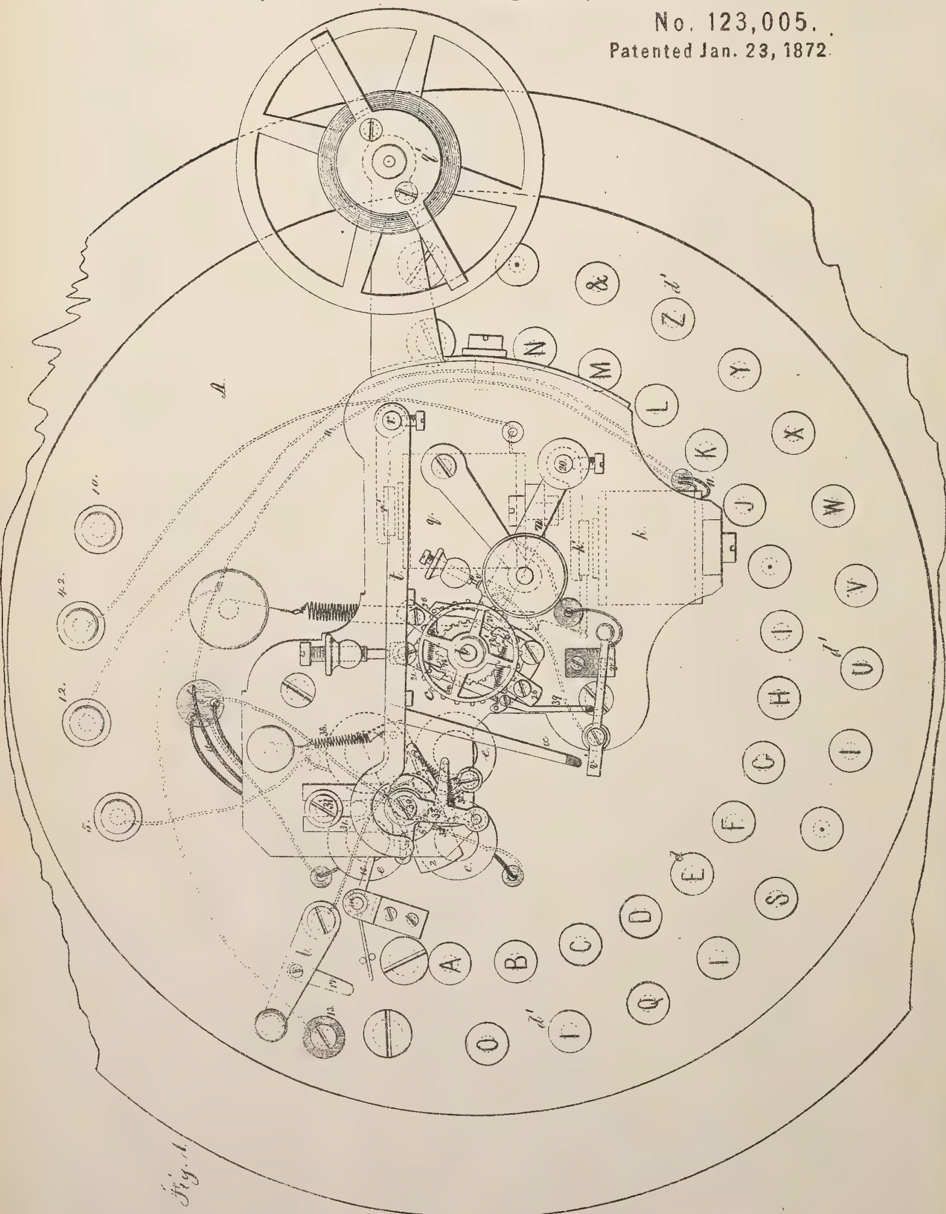
4 Sheets--Sheet 1.

THOMAS A. EDISON.

Improvement in Telegraph Apparatus.

No. 123,005.

Patented Jan. 23, 1872.



Witnesses.

Chas H Smith

Harold Serrell

Inventor.

Thos A. Edison

Lemuel W. Serrell

Atty.

4 Sheets--Sheet 2.

THOMAS A. EDISON.

Improvement in Telegraph Apparatus.

No. 123,005.

Patented Jan. 23, 1872.

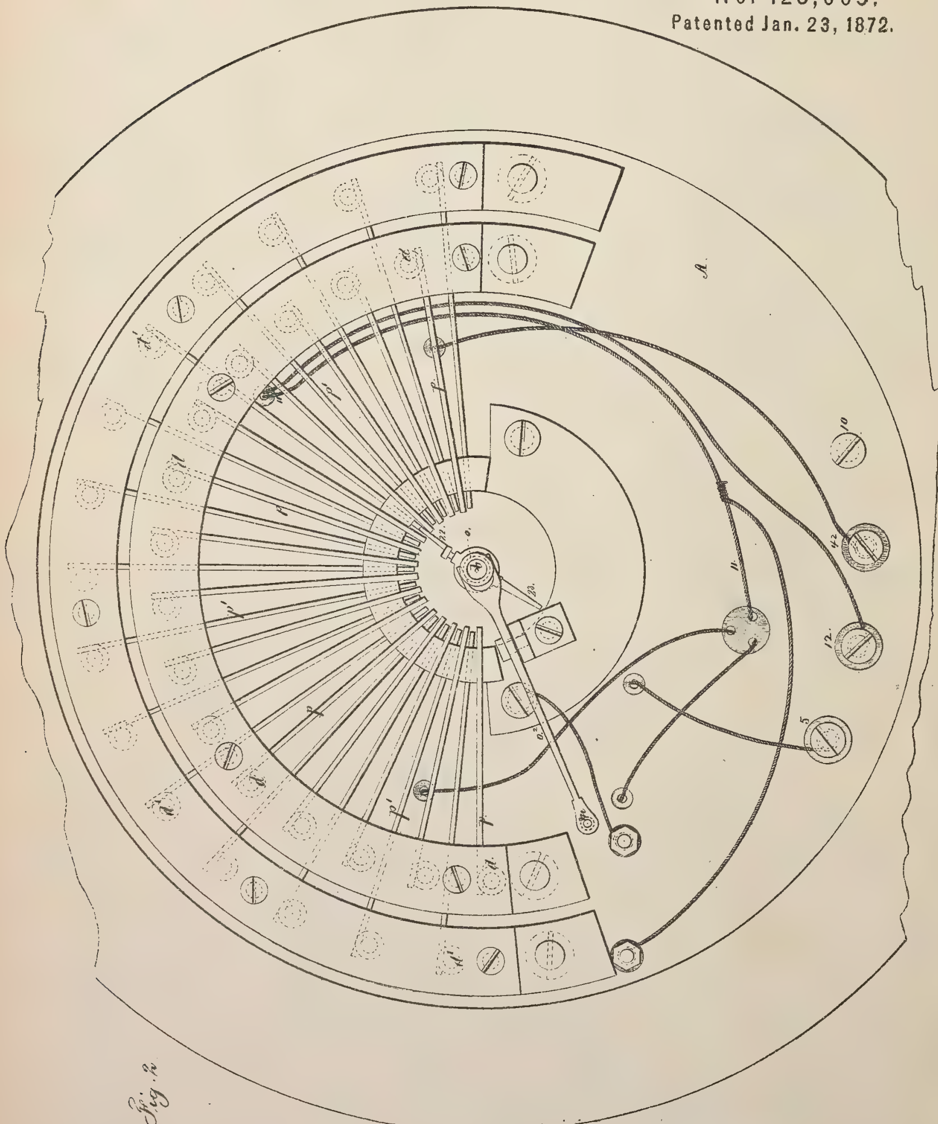


Fig. 2

Witnesses.

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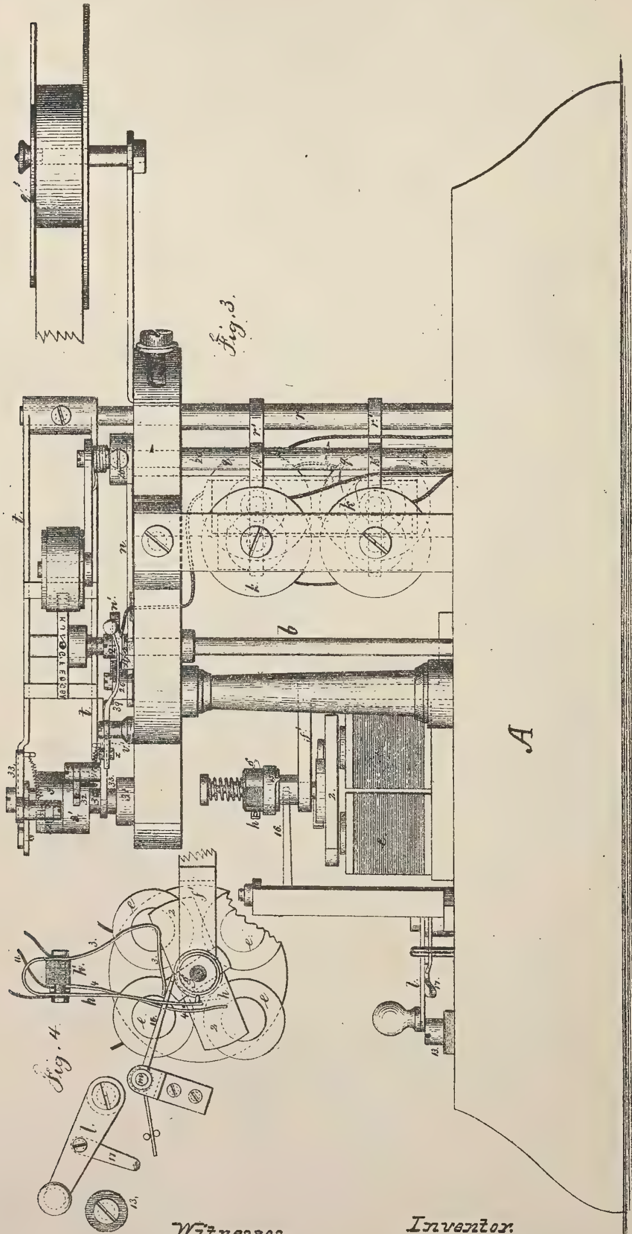
THOMAS A. EDISON. 4 Sheets--Sheet 3.

Improvement in Telegraph Apparatus.

No. 123,005. Patented Jan. 23, 1872.



Witnesses.

Chas H Smith

Harold Serrell

Inventor.

Thos. A. Edison

Lemuel W. Serrell atty.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

4 Sheets--Sheet 4.

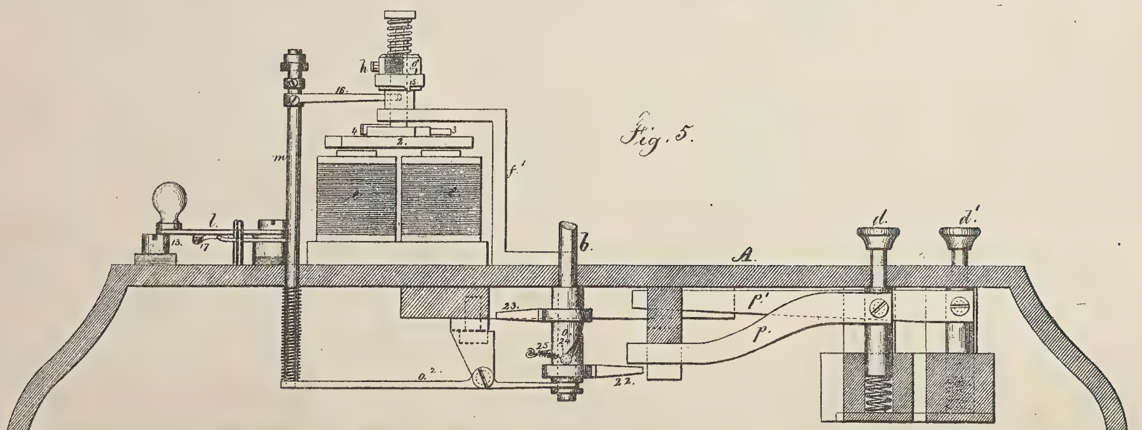
THOMAS A. EDISON.

Improvement in Telegraph Apparatus.

No. 123,005.

Patented Jan. 23, 1872.

Fig. 5.



Witnesses. Chs. H. Smith
Harold Serrell

Inventor Thos. A. Edison
Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO "THE GOLD AND STOCK TELEGRAPH COMPANY," OF NEW YORK CITY.

IMPROVEMENT IN TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. 123,005, dated January 23, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs; and the following is declared to be a correct description thereof.

This instrument I term the "Universal Printing-Telegraph;" and it is intended as a transmitting and as a receiving instrument. When used as a transmitting instrument a small magnetic motor, driven by a local battery, makes and breaks the main circuit, and the pulsations operate through a magnet in the transmitting-machine, and also in the receiving-machine or machines, to rotate the type-wheel by a step-by-step movement, and the type-wheels, hence, move in harmony. When a finger-key at the transmitting-station is depressed the type-wheel of that machine is stopped, when an arm upon its shaft comes in contact with the said key. This causes the simultaneous stoppage of pulsations over the main line, arresting all the type-wheels at the same point. The impression is now made simply in consequence of the pause that ensues, for the arm that operates the type-wheel pawls closes the circuit of the transmitting instrument through its own printing-magnet and the other printing-magnets of the line, and the impression is taken. The movement of the impression-lever breaks its own circuit, so that the pad is drawn instantly back by the spring of the impression-lever, and the circuit to the printing-magnet remains broken until the type-wheel is set in motion again, which throws a switch that again closes the circuit to the printing-magnet. The rapidity of movement, however, of the type-wheel lever is such that the printing-magnet does not have time to become sufficiently charged to move the printing-lever before the circuit to said magnet is again broken; hence the printing-magnet is not brought into action except when the pause takes place upon stopping the type-wheel. The circuit through the printing-magnet may either be the main circuit or a local.

In the drawing, Figure 1 is a plan of the instrument. Fig. 2 is an inverted plan. Fig. 3 is a partial side view. Fig. 4 is a plan of the motor and connections, and Fig. 5 is a section, showing the loose sleeve and incline that operate the stop for revolving pulsator.

The bed A is provided with a shaft, *b*, upon which is the type-wheel *c*. This shaft *b* is the center of the semicircular ranges of keys *d d'*, the number of which corresponds to the divisions upon the type-wheel; and they should be marked with similar characters arranged properly for the type-wheel. Upon the bed A is a magnetic motor, made of a pair of magnets, *e e*, armature 2, and spring circuit-closers 3 4, connected with the binding-screws 5 and 10 and a local battery, by means of which the armature 2 will be rotated with rapidity. The armature 2 is on a vertical shaft in the frame *f'*, and upon this shaft is the pulsator *g* and a friction-spring that causes the necessary power to be applied to rotate the pulsator, but allows the motor to continue when the pulsator is arrested. This pulsator *g* is made cylindrical, but of alternate conducting and non-conducting materials, and a spring, *h*, rests against the side thereof, and is supported by a column of non-conducting material, *h'*. The metallic connection from the main-line battery is through the binding-screw 10 to the bed of the machine, through the shaft and conducting-surface of the pulsator *g*, spring *h*, and wire 11, to the magnet *k* that moves the type-wheel; thence to the binding-screw 12, main line, and distant instrument. At the distant instrument the switch *l* is moved to the insulated anvil 13, and connects the bed and screw 10 of the machine with one of the wires of the magnet *k*, the other wire of the magnet going to the binding-screw 12, and the pulsator of the receiving-machine is instantaneously stopped, so that all the instruments in the line may be moved by the pulsator at the sending-station only. Upon the pulsator *g* there are catches, 15, and an arm, 16, upon a vertical sliding shaft, *m*, is raised by the finger 17 of the switch *l* so as to be in the path of one of the catches 15, to arrest the further revolution of the pulsator of the receiving-machine at a point when the arm 16 is upon the non-conducting surface. Thereby the circuit through the pulsator is broken, but connected through the switch *l*, as aforesaid. The motors at the receiving-station may continue to revolve, but are not operative. All the magnets *k* in the line are oper-

ated in unison by pulsations from the pulsator of the transmitting-machine, and in each machine the armature k' swings on the shaft 20 and operates the lever n, that carries the pawls 21 and stops 26, to the ratchet-wheel n', upon the shaft b of the type-wheel c; hence all the type-wheels will move around in unison with a step-by-step motion; and when the pulsator at the sending-station is stopped all the type-wheels in the circuit stop, and they stand at the same points.

I next proceed to describe how the pulsator is stopped at the sending-station when its type-wheel and all others in the circuit are in position to have letter impressed corresponding to the finger-key d or d' that is acted upon. The type-wheel shaft carries a sleeve, o, with fingers 22 and 23 on opposite sides, and one below the other. The keys d d' being in semicircular ranges, each key has an arm below the bed A, extending radially toward the shaft b. The arms p are upon the keys d, and act with the fingers 22, and the arms p' are upon the keys d' and act with the fingers 23.

In the normal position the fingers 22 and 23 revolve clear of the arms p p', but when a key is depressed the arm of that key stops the finger 22 or 23 and sleeve o. In this sleeve o is an inclined slot with a pin, 24, from the shaft b therein, and a slight spring, 25, yields as the sleeve is stopped, and the shaft b continues to move sufficiently to give the sleeve o a downward movement by the pin 24 in the inclined slot, and by the lever o^2 lift the vertical sliding rod m and arm 16, stopping the pulsator and all the type-wheels with the types corresponding with the depressed key in position ready for printing.

I next describe the means for giving the impression. The printing-lever t is upon the shaft r, that is operated upon by the armature r' of the electro-magnet q. The paper passes from the reel q' in front of the impression-pad, and then between the roller-segments s s' and clamps 32. These roller-segments are upon a stationary stud, 30, that is adjustable by the slotted frame and screw 31, and upon the respective roller-segments s s' are arms 33, carrying the feeding-clamps 32, and slotted ends to the arms 33 are acted upon by pins in the printing-lever t. The parts are in reverse position, so that one clamp acts to pull the paper along as the printing-lever moves one way, and the other clamp acts as the lever moves the other way, thereby moving the paper along each impression. By this arrangement the printing-lever acts to better advantage to swing the feeding-clamps than in the devices heretofore employed. A spring, 38, draws back the printing-lever. A circuit-closer, v, comes in contact with the type-wheel lever n every pulsation, but the contact is so instantaneous that the electro-magnet q has not time to act against its tension-spring to give the pulsation; but the moment the pulsator stops, and the type-wheel also stops by the circuit of the pulsator being broken, the contact of v and n closes the circuit from the screw 10, and bed of the machine through the lever n, closer v, lever v^1, insulated plate v^2, and wire to the magnet q, thence to the binding-screw 42, and this circuit may be part of the main line, or a local circuit at each station. The closing of this circuit gives the impression and feeds the paper, and also breaks its own circuit, for as the printing-lever comes up to give the impression the insulated arm x projecting from the printing-lever t moves the lever v^1 off the plate v^2, and breaks the circuit through the printing-magnet so that the printing-lever is instantly drawn back by its spring.

As soon as the operator at the transmitting-station raises his finger from the depressed letter-key that key is raised by its spring, the sleeve o is turned back by its spring 25, the sliding rod m and arm 16 drop, and the pulsator is again revolved by its motor, and all the type-wheels start off upon their rapid step-by-step rotation in harmony, until another key is depressed and the operation is repeated. The arm 39 from the lever n replaces the switch-lever v^1 in contact with the plate v^2, the first movement of the lever of the type-wheel hence the circuit connection is restored ready for the next printing operation.

I claim as my invention—

1. A pulsator driven by friction, and acting to make and break an electrical circuit in which are the magnets, operating two or more type-wheels in unison, substantially as set forth.

2. The pulsator constructed substantially as set forth, in combination with a magnetic motor and the type-wheel and its magnet, substantially as set forth.

3. The pulsator g and its arm 16, in combination with the switch l and the metallic connections, substantially as set forth, for stopping the pulsator at the receiving-station and completing the electric connections to the type-wheel magnets.

4. The type-wheel shaft b and type-wheel c, in combination with the sleeve o and its incline for giving an end movement to the sleeve when its rotation is arrested, substantially as set forth.

5. The arms 22 and 23 and sleeve o, in combination with the keys d d' and the pulsator stop 16, and pulsator g, substantially as and for the purposes set forth.

6. The feeding-roller segments s s' and pawls 32, arranged substantially as shown, and operated by the printing-lever t acting upon the arms 33, substantially as shown.

7. The printing-lever magnet in an electric circuit that is closed by the movement of the lever that operates the type-wheel, substantially as set forth, so that the printing-magnet is brought into action by a pause in the rotation of the type-wheel.

8. The lever or switch v^1, in combination with the impression-magnet and printing-lever, substantially as set forth, for breaking

the circuit automatically to the printing-magnet.

9. The printing-lever t and magnet in combination with the type-wheel lever n, arms x and 39, and switch-lever v^1, substantially as and for the purposes set forth.

10. A type-wheel moved with a step-by-step movement, an electro-magnet for the same, and a pulsator, in combination with a secondary circuit to the printing-magnet operated automatically, substantially as set forth.

11. A series of printing-telegraph instruments arranged in one main electrical circuit and operated by the pulsator of any one machine in that circuit acting as a transmitter, and all the machines acting in harmony as receiving-machines, the pulsation in each receiving-machine being stopped or thrown out of action, substantially as set forth.

12. A printing-telegraph instrument containing a pulsator, type-wheel, type-wheel magnet, a switch, and letter-keys, substantially as specified, so as to act as a receiving or transmitting machine by the movement of the switch, as specified.

Signed by me this 26th day of July, A. D. 1871.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

Thomas A. Edison.

Impt. in Printing Telegraphs.

Fig. 1.

No. 123,006. Patented Jan. 23, 1872.

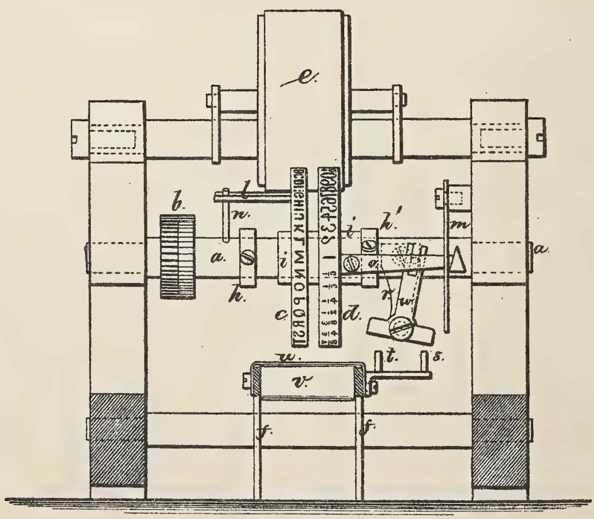


Fig. 3.

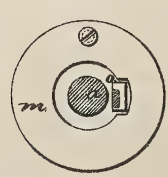
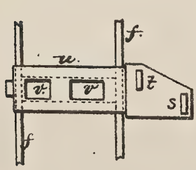


Fig. 2.



Witnesses

Chas H Smith

Harold Serrell

Thomas A. Edison

Lemuel W. Serrell

att.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO "THE GOLD AND STOCK TELEGRAPH COMPANY," OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 123,006, dated January 23, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

In Letters Patent No. 113,034 a printing-telegraph is shown with a shifting pad that takes an impression from one of two type-wheels upon a shaft rotated by a ratchet and lever. My present invention is a modification of and improvement upon the said invention, and relates to devices for moving the type-wheel upon the shaft and thereby bringing one wheel into position for printing and throwing the other one out of action.

In the drawing, Figure 1 is an elevation of the said machine. Fig. 2 is a plan of the shield for the impression-pad, and Fig. 3 is the stationary guard-ring to prevent the type-wheels moving except at a given point.

The type-wheel shaft *a* is actuated by pawls, a lever, armature, and magnet, not shown in the drawing, but which may be of any desired or known character, the pawls acting upon the ratchet-wheel *b*. The type-wheels *c d* are inked by the drum *e*, as usual, and the impression-lever *f* is operated by a magnet in the usual manner. The type-wheels *c d* are attached upon a sleeve, *i*, that slides freely upon the shaft *a*, and the extent of motion is determined by the collars *h h* or other stop, and there is either a feather or polygonal shaft to insure the rotation of the type-wheels with the shaft, or else the projecting rods *l* are employed, passing at opposite sides of the arm *n* projecting from the shaft. I prefer this last-named device, as most free from friction. The arm *o* projects from the sleeve *i*, and has a V-cam at the end running at either one side or the other of the stationary ring *m*, and hence holding the wheels with the sleeve in contact with either the stop *h* or *h'*; but in this ring *m* is a notch that allows the V-cam to pass at the point where the type-wheel can be shifted. An arm, *r*, attached to the shaft *a* carries a T-lever, *w*, one arm of which is connected by a slot and pin with the arm *o*; the other arms are in the path of the finger *s* and *t* upon the printing lever *f*. A shield, *u*, covers the impression-pad *v*, but has openings through which the impression can be made. If the type-wheel is turned so that the lever *w* is stopped over the finger *s* and then the impression-lever moved there will be no impression, there being a blank in the type-wheel at that point, and the finger will act upon the lever *w* and shift the type-wheel so as to bring the other type-wheel into position over the opening in the shield, the shield preventing an impression from the other type-wheel. The finger *t* acts in a similar manner when brought in contact with the lever *w* to shift the type-wheels to the position shown in the drawing. The portion of the shield between the openings *v v* coming beneath the type-wheel that is not in use prevents an impression therefrom.

I claim as my invention—

1. Two type-wheels fitted to slide endwise of their shaft, in combination with mechanism substantially as specified, to give such end movement to the said type-wheels, and a shield to prevent an impression from more than one of the type-wheels, substantially as set forth.

2. The lever *w* connected with the type-wheel shaft and type-wheels, in combination with the fingers that are moved by the impression-lever, substantially as set forth.

3. The stationary notched ring *m*, in combination with the type-wheels *c d* fitted to slide endwise of the shaft *a*, substantially as set forth.

Signed by me this 26th day of July, A. D. 1871.

T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

THOMAS A. EDISON. 2 Sheets--Sheet 1.

Improvement in Telegraph Apparatus.

No. 123,984. Patented Feb. 27, 1872.

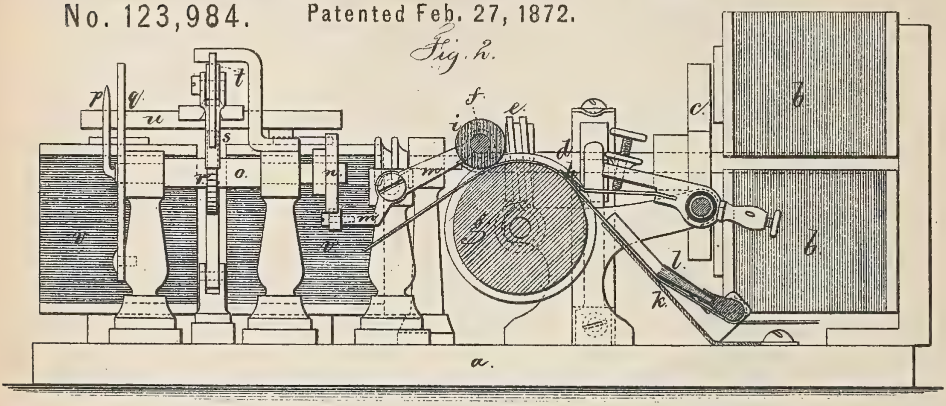


Fig. 2.

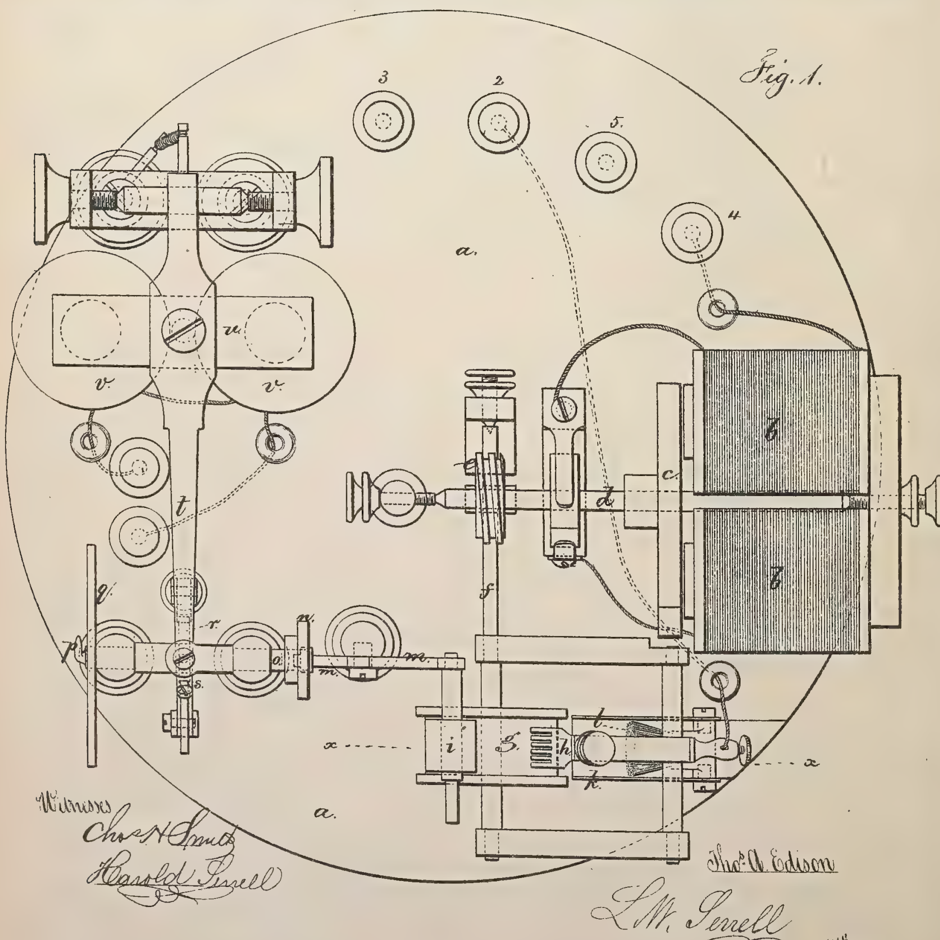


Fig. 1.

Witnesses

Chas. H. Smith

Harold Serrell

Thos. A. Edison

L. W. Serrell

atty

THOMAS A. EDISON. 2 Sheets--Sheet 2

Improvement in Telegraph Apparatus.

No. 123,984. Patented Feb. 27, 1872.

Fig. 3.

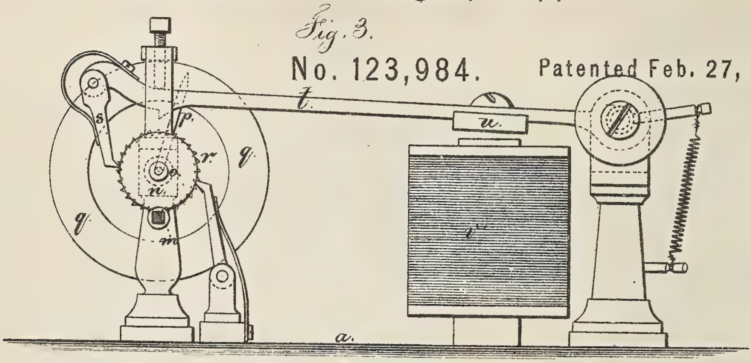
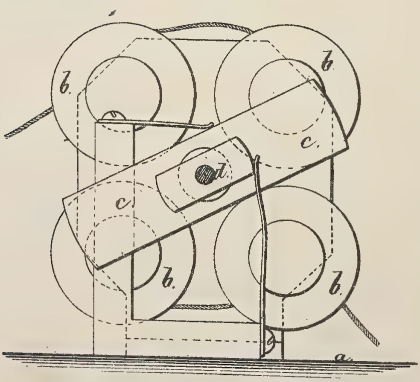


Fig. 4.



Witnesses

Chas H Smith

Harold Serrell

Thos A. Edison

Lemuel W. Serrell att.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. 123,984, dated February 27, 1872; antedated February 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraph Apparatus; and the following is declared to be a correct description thereof.

The object of this invention is to give the operator at the sending station the opportunity to adjust the instruments on the line in such a manner as to bring into action the receiving instrument at any desired station independently of the operator at that station.

This invention is primarily adapted to the transmission of messages automatically by perforated paper, and their reception upon chemically-prepared paper; but the said invention may be employed in other telegraphic apparatus.

In the drawing, Figure 1 is a plan of the instrument complete. Fig. 2 is a section at the line *x x*. Fig. 3 is an elevation of the locking-wheel and its magnet, and Fig. 4 is an elevation of the motor.

The bed *a* is of suitable size, and carries the magnets *b b*, revolving armature *c*, shaft *d*, and worm-pinion *e*, forming a motor for the shaft *f* and transmitting or receiving roller *g*. *h* is the transmitting brush, roller, or pen, or the receiving stylus or pen is substituted for the same. The perforated paper or the receiving-strip passes through the trough *k*, and the brush *l* applies to the same the required friction to keep the paper in position. The binding-screws 2 and 3 are for the main-line wire, one connecting to the stylus and the other to the roller *g* through the metallic bed. The binding-screws 4 and 5 connect a local battery to the magnets *b b*.

I remark that the magnets *b b* and armature simply form a well-known motor for the machine, and that any other motor may be applied to revolve the roller *g*, and that this roller *g* and the parts connected therewith may be of any desired character and adapted to the automatic reception or transmission of telegraphic messages.

My special feature of improvement relates to an actuating mechanism applied to each machine, which, when brought into operation by the party at the transmitting station, causes the machine at the receiving station to become operative.

The roller *i* is mounted upon a lever, *m*, at the other end of which is a lock-wheel, *n*, having one notch. When this wheel *n* is turned around, so that the lever *m* or roller at its end passes into this notch, the roller *i* presses the paper upon the roller *g* by its own weight, or the force of a spring, sufficient to cause the paper to be drawn along between the rollers *g* and *i;* but when the roller *i* is raised by the circular portion of the lock-wheel *n* acting upon the lever *m*, the instrument is thrown out of action, and this movement of the lever *m* may also be made to switch the current away from its machine or direct it through the receiving or transmitting portions thereof. Upon the shaft *o* of this lock-wheel *n* is a hand, *p*, to the dial *q*, and also a ratchet-wheel, *r*, for the pawl *s* of the lever *t*. The armature *u* and and magnet *v* are employed to actuate the ratchet *r* and lock-wheel *n*. This magnet *v* is in a separate main telegraph-circuit with a line-wire independent of that leading to the transmitting or receiving apparatus, or else it is placed in a shunt and the spring of the lever *t* set up, so that this apparatus will not be operative by the ordinary rapid pulsations in telegraphing. There are as many teeth in the ratchet *r* as there are stations on the line and on the dial *q*. The names or numbers of the stations are placed, and the position of the notch in the lock-wheel *n* is such in relation to the hand *p* that the notch will receive the lever *m* when the hand indicates the particular station; hence the operator at the transmitting station, by a dial or finger key, turns his own pointer to the name or number of his own station, then holds the lever *t* by his hand or a lock, and proceeds to manipulate the key until the station is indicated to which the message is to be sent; all the dials in the line indicating that same station, only the instrument at that station will be locked into action by the lever *m* and roller *i;* and hence the machines at the transmitting and receiving stations are in position for the message to be sent and received. The strip of paper may be prepared with long perforations of the proper numbers at the commencement and end, so as to move the lock-wheels of the instruments and determine the instrument at which the message is to be received, and the long perforations at the end of the strip will bring the lock-wheels

and indexes around to the nonius or starting points.

In this manner the operator at the receiving station does not have to attend to the reception of the message, and the party at the transmitting station only has to set the dials, and, rfter sending the message, work his own instrument by hand around so that his index corresponds with the others in the line.

In place of long perforations for setting the instruments of the line, the speed of the transmitting motor might be made sufficiently slow to allow the pulsations to be of the required intensity.

I claim as my invention—

1. The lock-wheel *n*, lever *m*, and roller *i*, operated by an electro-magnet, substantially as set forth, for bringing into action the receiving instrument.

2. The roller *g* and transmitting or recording stylus or brush and the roller *i*, to press upon the paper and cause the movement thereof, in combination with mechanism, substantially as specified, for throwing the receiving instrument out of action by releasing the pressure of said roller *i*, as set forth.

3. A series of automatic telegraph instruments in one main telegraph-line, with locking mechanism and indicators, operated by electro-magnets, and arranged, substantially as set forth, so as to throw into action the desired receiving instrument, as specified.

Signed by me this 26th day of July, A. D. 1871.

T. A. EDISON.

Witnesses:

CHAS. H. SMITH,
GEO. T. PINCKNEY.

1872

T. A. EDISON. Improvement in Telegraphic Recording Instruments.

No. 124,800. Patented March 19, 1872.

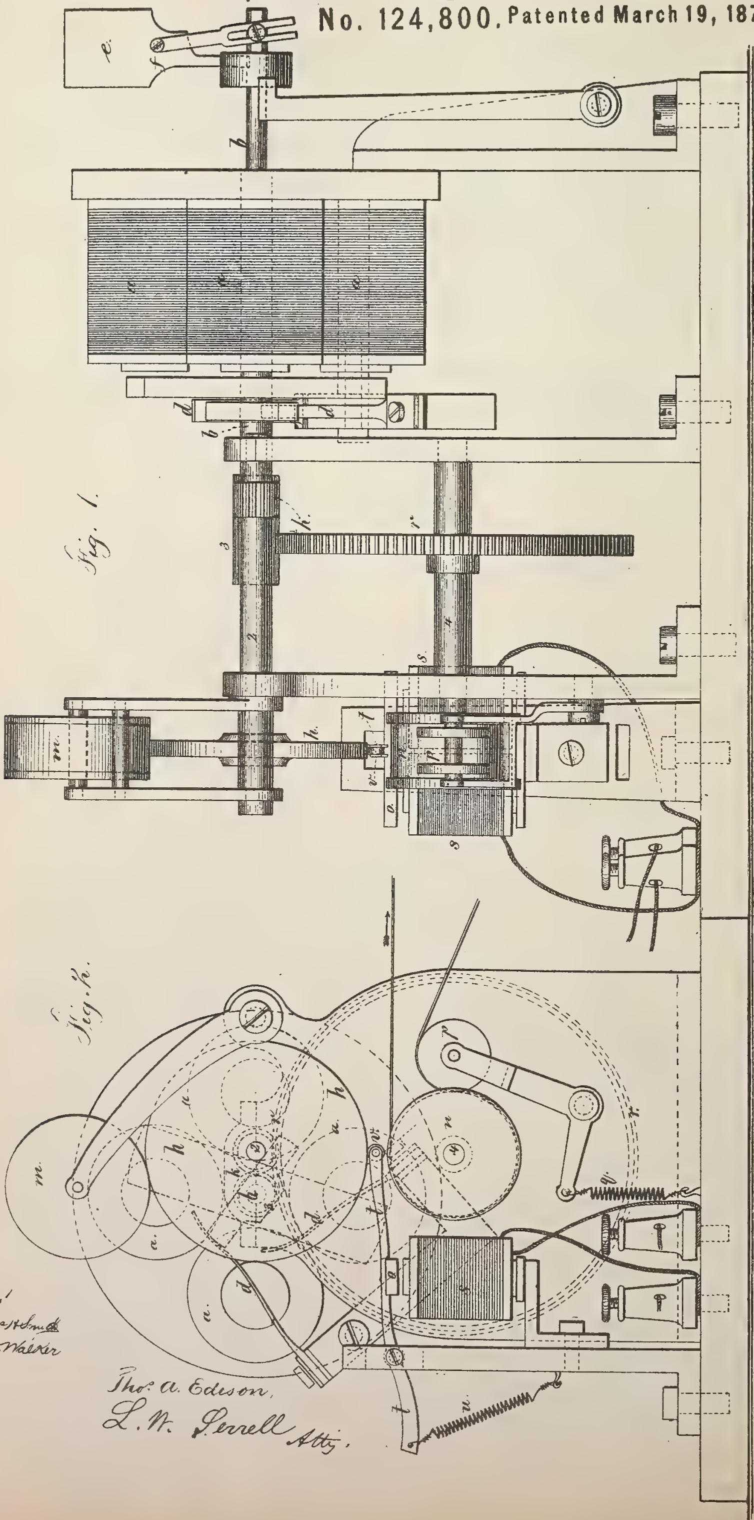


Fig. 1.

Fig. 2.

Witnesses
Chas. H. Smith
Geo. D. Walker

Thos. A. Edison,
L. W. Serrell Atty.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE PROCESS.)

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN TELEGRAPHIC RECORDING INSTRUMENTS.

Specification forming part of Letters Patent No. 124,800, dated March 19, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Ink Recording Instruments; and the following is declared to be a correct description thereof.

This invention is made for marking upon a strip of paper in dots and dashes in ink at the receiving-station to correspond with the message composed in a strip of paper by perforations, and employed for producing pulsations at the transmitting-station. The present improvement relates to a roller vibrated by a magnet between the paper and an inking-wheel, said inking-wheel moving with sufficient velocity to apply ink to the periphery of said roller when in contact.

In the drawing, Figure 1 is a side view of the motor and the parts moving the inking apparatus, and Fig. 2 is an elevation of the ink recording device.

The motor which I prefer and employ consists of four helices, *a a*, acting upon a revolving armature sustained by the shaft *b*, the electrical pulsations to the magnets passing through the circuit-closing springs *d d* from a local battery, and the fan *e* and point *f* acting to regulate the speed, as in my patent No. 111,112, granted January 24, 1871.

The inking-wheel *h* is driven at a rapid speed by the gearing *k* to the shaft 2, and said wheel *h* is in contact with the inking-drum *m*, that has an elastic surface, saturated sufficiently with ink to keep the edge of the wheel *h* in proper condition. This wheel *h* is, by preference, made of hard rubber. The strip of paper passes around the roller *n*, being kept in contact by the pulley *p* and spring *q*, and the roller *n* is driven at a sufficiently slow speed by the pinion 3 gearing into the wheel *r* on the shaft 4 of said roller *n*. The pulsations of electricity to be recorded pass through the electro-magnet *s*, either directly on the main line or through a branch circuit or local relay.

The armature *o* is upon the lever *t*, and the weight is balanced by a spring, *u*, or otherwise, and at the end of the lever *t* is the ink recording-roller *v*. In the normal position the spring *u* keeps this roller *v* in contact with the wheel *h*, but a pulsation of electricity in the magnet draws down the roller, making a mark upon the paper, and according to the duration of the pulsation so the ink-mark will be a dot or a dash. The periphery of the roller *v* should be of as great length as the longest dash, and the moment the magnetism ceases to hold down the roller *v* the same flies up into contact with the wheel *h* to receive more ink, and the speed of the wheel *h* should be such as to revolve the roller *v* once each time it comes in contact therewith, no matter how rapidly the pulsations are sent. An inking band might interpose between the roller *v* and paper, but I prefer the device shown.

I claim as my invention—

1. A roller raised and lowered by the action of an electro-magnet, and acting to impress ink upon a strip of paper in dots and dashes, substantially as set forth.

2. The inking-wheel *h*, in combination with the roller *v* and electro-magnet *s*, substantially as set forth.

3. The inking-wheel *h* and roller *v*, in combination with the electro-magnet *s*, for moving said roller *v*, and the magnetic motor for actuating the wheel *h* and paper-roller *n*, substantially as set forth.

Signed by me this 12th day of August, A. D. 1871.

T. A. EDISON.

Witnesses:
HAROLD SERRELL,
CHAS. H. SMITH.

THOMAS A. EDISON.

Improvement in Type-Wheels for Printing-Telegraphs.

No. 126,528. Patented May 7, 1872.

Fig. 1.

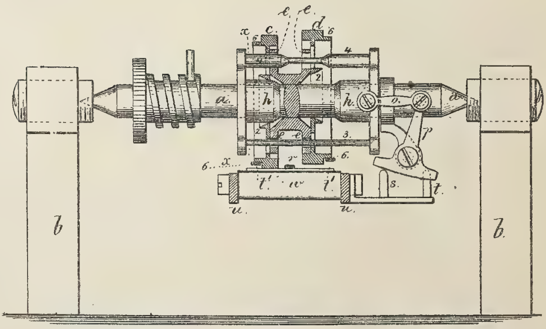


Fig. 2.

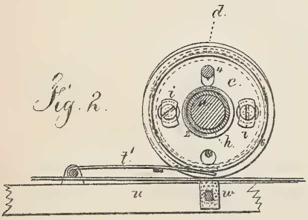
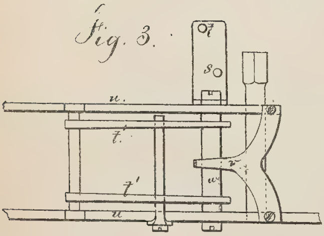


Fig. 3.



Witnesses
Chas H Smith
Geo. D. Walker.

Inventor
Thos. A. Edison
Lemuel W. Serrell atty.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN TYPE-WHEELS FOR PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,528, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs, and the following is declared to be a full and correct description of the same.

In an application for Letters Patent of like date herewith, the type-wheels of a printing-telegraph instrument are shown, constructed so that they can be expanded and contracted in order that the larger wheel may be printed from without impressing from the smaller or contracted wheel.

My present invention is a modification of the devices above mentioned; and the same consists of type-wheels with hubs fitting loosely upon the type-wheel shaft, but connected by screws and slots to disks secured to and revolving with said shaft. Conical-ended sleeves are also upon the type-wheel shaft, and they are arranged and operated so that when one sleeve is within the hub of one wheel, said wheel will be concentric with its shaft, and may be printed from; but the other sleeve will be out of the hub of its wheel, and allow a spring to act upon the lower portion of the wheel, and raise it sufficiently to prevent an impression while the other wheel is being printed from. A locking-bar, moving with the sleeves, locks the wheel, which is concentric with the shaft.

In the drawing, Figure 1 is an elevation of a type-wheel shaft with the wheels in section. Fig. 2 is a section at the line *x x;* and Fig. 3 is a plan of a portion of the printing-lever.

a is the type-wheel shaft, mounted in the side frames *b b*, and this shaft is to be revolved by a step-by-step motion, as usual. *e e* are disks secured to the shaft *a*, and revolving with the same; and to these disks *e e* the type-wheels *c d* are loosely connected by the screws and slots at *i i* that keep the type-wheels in contact with the disks, but allow of free lateral motion. Each type-wheel is made with a hub, 2, surrounding the shaft *a*, but of larger diameter, so that a conical-ended sleeve, *h*, may enter said hub to center the wheel and bring it concentric with the shaft *a*. There are two of these sleeves *h* upon the shaft *a*, and connected to each other by the rods 3 and 4, the latter being also a locking-bar to prevent any lateral movement of the wheel, which is concentric with the shaft *a*. This locking-bar is made with a small portion in the middle, so that it will allow the free movement of the wheel that is not locked, but will fill up the hole in the wheel that is locked, and thereby keep it in position. These sleeves are arranged as shown in Fig. 1, and are moved by the T-lever *p*, which is connected to one of the sleeves by the link *o*, and this lever *p* is moved by one of the pins *s t* on the upward movement of the printing-lever *u* when the type-wheel is at the blank point.

It will now be understood that when one of the type-wheels is upon its sleeve *h*, it is concentric with the shaft *a*, and may be printed from; the other wheel is off of its sleeve, and, if not otherwise provided for, would hang loosely upon the shaft and blur the paper when an impression was made from the other wheel. To prevent this I provide springs *t′ t′*, that may be secured to the printing-lever *u*, and these springs take against flanges 6 upon the respective type-wheels *c d*, and the wheel which is loose upon the shaft is kept up by the spring *t′* in the position shown in Figs. 1 and 2, so that the lower portion of the wheel is higher than the lower portion of the other wheel, and cannot make an impression upon the paper. A spring-finger, *v*, is employed to keep the strip of paper in contact with the impression-pad *w* and prevent blurring.

I claim as my invention—

1. The type-wheels *c d*, each connected to the disk *e*, but allowed to move laterally, in combination with the sliding sleeves *h h*, substantially as specified.

2. The locking-bar 4 and springs *t′ t′*, in combination with the laterally-moving type-wheels, substantially as and for the purposes set forth.

Signed by me this 23d day of January, A. D. 1872.

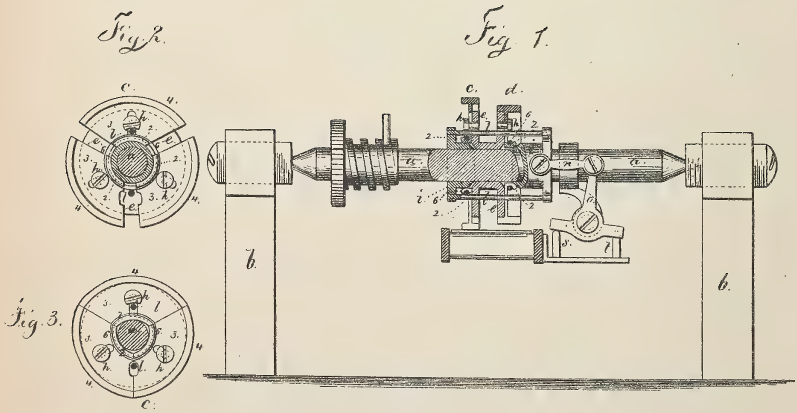
T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

THOMAS A. EDISON.

Improvement in Type-Wheels for Printing-Telegraphs.

No. 126,529. Patented May 7, 1872.



Witnesses
Chas H Smith
Geo. D. Walker

Inventor
Thos. A. Edison
Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN TYPE-WHEELS FOR PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,529, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs; and the following is declared to be a full and correct description of the same.

In Letters Patent heretofore granted to me printing-telegraph instruments are shown with two type-wheels upon a revolving shaft and fitted so that either of them may be printed from without impressing from the other type-wheel—shifting type-wheels and shields are employed for this purpose.

My present invention is to accomplish the same object by the use of different means. I employ two type-wheels, each divided radially into sections and each section connected by screws and slots to a disk secured upon the type-wheel shaft so that the sections can be moved away from or toward said shaft to increase or decrease the diameter of the wheel. For this purpose I employ sleeves sliding freely on the type-wheel shaft and provided with conical ends to enter the divided hubs of the wheels, and said sleeves are arranged so that when one sleeve enters the hub of its wheel the other sleeve will be withdrawn from the hub of its wheel, by which means the first wheel will be increased in diameter and its periphery be concentric with its shaft and may be printed from, but the second wheel will be contracted in diameter and cannot impress the paper while the other wheel is being printed from.

In the drawing, Figure 1 is an elevation of a type-wheel shaft with the type-wheels in section. Fig. 2 is an elevation of a type-wheel as expanded, and Fig. 3 is a similar view of the wheel contracted.

a represents the type-wheel shaft, supported in bearings in the side frames *b b*, and this shaft is to be revolved by a step-by-step motion, as usual. *c d* are the type-wheels, each divided radially, as seen in Figs. 2 and 3, so as to form a sectional hub, 2, disk 3, and flange 4, the latter being provided with letters or numbers upon its outer surfaces. I have shown the type-wheels as each divided into three sections, and the sections composing the wheel *c* or *d* are connected by slots and screws *h h* to disks *e e*, which are secured to the type-wheel shaft and revolve with the same. The slots are radial with the shaft *a*, and the screws *h h* guide and limit the sections in their movement. *i i* are sleeves, sliding freely upon the shaft *a* and connected to each other by the rods *l l*, which pass through openings in the disks 3 3 and *e e*. Each of these sleeves is made with a conical end to enter the hub of the type-wheel and move the sections away from the shaft *a*, so as to increase the diameter of the wheel and make its periphery concentric with the shaft *a* so that the same may be printed from. These sleeves *i i* are arranged, as shown in Fig. 1, so that one sleeve is within its hub 2 and the wheel expanded, while the other sleeve is out of its hub and the wheel contracted by the rubber spring 6, which encircles the divided hub 2 and draws the sections toward the shaft.

To move the sleeves *i i* so that either wheel may be increased in diameter and printed from, I make use of the link *n* connected to one of the sleeves *i* and to a T-lever, *o*, which latter is moved by the pin *s* or *t* upon the upward movement of the printing-lever when the type-wheel is at the blank point. The pin *s* is slightly in advance of the pin *t*, and the operation of these pins and T-lever is the same as in my previous patents where the type-wheel or pad is shifted.

With a type-wheel constructed in three sections there will be three openings between the said sections, but the types may be close to the edges of these sections so as to be equidistant when the type-wheel is expanded.

The wheels are to be placed so that the sleeves may be shifted when a blank space is over the impression-pad, so that an impression will not be made when the sleeves are shifted by the upward movement of the printing-lever.

I claim as my invention—

The type-wheels, each divided into sections and connected to the disk *e*, in combination with the sliding sleeves *i i* for expanding the wheel, or allowing of its being contracted, for the purposes, and substantially as set forth.

Signed by me this 23d day of January, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,530. Patented May 7, 1872.

Fig. 2.

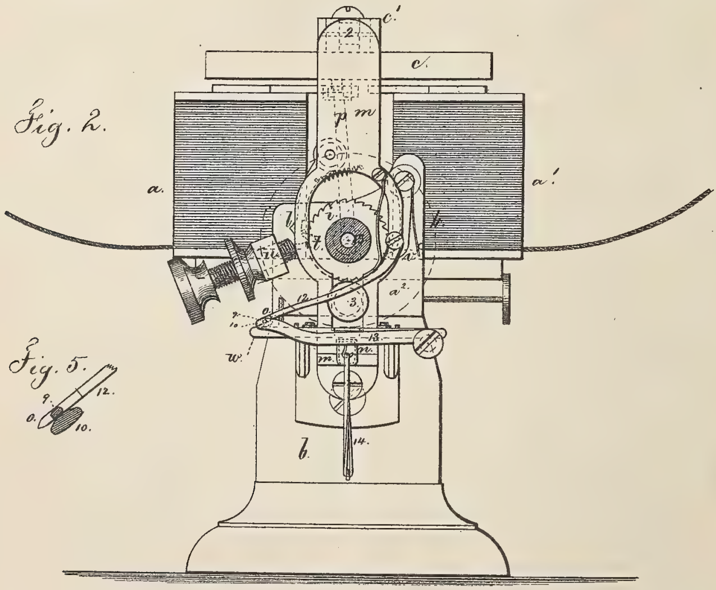


Fig. 5.

Fig. 1.

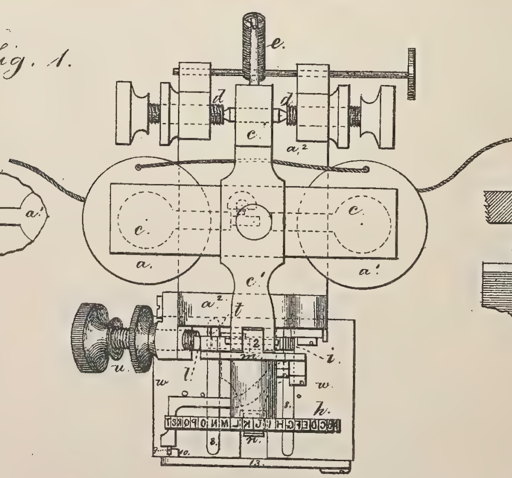


Fig. 3.

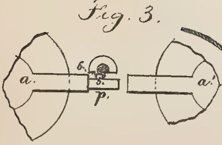
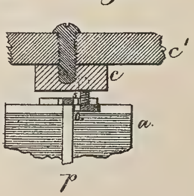


Fig. 4.



Witnesses

Chas H Smith

Geo. D. Walker

Inventor

Thomas A. Edison

Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,530, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made a new and useful Improvement in Printing-Telegraphs; and the following is declared to be a full and correct description of the same.

My present invention consists of a printing-telegraph instrument in which the type-wheel is revolved and the printing and feeding mechanism operated by a movement communicated from the same armature of an electro-magnet. I make use of a type-wheel revolved by a step-by-step movement derived from the vibration of the armature of an electro-magnet, and between lateral arms from the cores of said electro-magnet is a swinging polarized bar, which, when attracted toward one of said arms by magnetism induced by a current of one polarity, allows the armature to be vibrated by pulsations of the same polarity and the type-wheel to be revolved; but a stop on said bar setting over a projection on the armature limits the upward movement of the armature and prevents the printing and feeding mechanism acting until the current is reversed, which then throws the polarized bar to the other pole of the electro-magnet, disconnecting the stop from the armature and allowing the same to have its full upward and downward movement to effect the printing and feed of the paper.

In the drawing, Figure 1 is a plan of my improved instrument. Fig. 2 is an elevation of the same with the type-wheel removed, but its position shown by dotted lines. Figs. 3 and 4 are detached views illustrating the device which limits the movement of the armature, and Fig. 5 is a sectional view of a portion of the feeding device.

The electro-magnet a a^1 is supported in a frame, a^2, upon the base b, and the armature c of said magnet is secured to the lever c', which swings upon the screw-centers d d. The spring e gives the upward movement to said lever c' and the parts connected to it. h is the type-wheel, upon a sleeve fitted to revolve freely on a gudgeon extending from the frame a^2, and to this sleeve is secured the ratchet-wheel i, which is turned, to rotate the type-wheel, by the pawl l pivoted upon the vertical bar m. This bar m is connected at its upper part by a joint, 2, to the lever c', which allows a free vertical movement to the bar, and it is guided by the pin and slot 3. This bar is made with an opening so as to pass around the gudgeon and sleeve of the type-wheel, and said bar carries the impression-pad n and paper-feeding dog or clamp o. p is the polarized bar between the lateral arms of the cores of the magnet a a^1, and it swings upon the center 15. At the top and upon one side of the bar p is a stop, 5, and upon the under side of the armature c is an L-shaped projection or stop, 6. When a pulsation of one polarity is sent through the magnet a the bar p is repelled from the core or arm of the magnet a^1, and attracted to the position shown most clearly in Fig. 3, where the stop 5 is immediately over the stop 6, and in this position the armature can be vibrated by pulsations of that polarity and the type-wheel revolved by the lever c', bar m, pawl l, and ratchet i, to bring the desired letter in position for printing; but an impression will not be made, because the stops 5 and 6 limit the motion of the armature and prevent the lever c' and connected parts receiving the full upward movement necessary for printing. When the polarity of the current is reversed the bar p is attracted by the magnet a^1, which disconnects the stops 5 and 6 and allows the spring e to give the full upward movement to the lever c', bar m, and impression-pad n, and effect the printing before the accumulation of force in the magnet a a^1 is sufficient to draw down the armature and feed the paper at the same time that the type-wheel is moved. The full downward movement of the lever c' and bar m actuates the dog o and feeds the paper the proper distance. The polarity of the current is now reversed, and the bar p will be moved to its normal position with the stop 5 over the projection 6; but there is sufficient play to allow the armature c to be vibrated so that the necessary movement is given to the lever c', bar m, and pawl l to rotate the ratchet-wheel i and type-wheel h as before. A pin, t, upon the frame a^2 takes against the under side of the pawl l and lifts it from contact with the teeth of i, when the full downward movement is given to the bar m, and prevents said wheel being turned more than one tooth by such

downward motion of the bar. *u* is a set-screw to determine the downward movement of the bar *m* and stop the rotation of the ratchet *i* and type-wheel *h*, and *v* is a pawl to prevent the ratchet *i* turning backward. The paper passes over the table *w* and beneath the spring-fingers 8 8, and in this table is an opening to allow the pad *n* to press the paper against the type-wheel and make the impression. The feeding-dog *o* is, at the outer end of an arm, 12, pivoted to the bar *m*, and at the side of this dog *o* is a pin, 9. When the type-wheel is being rotated the pin 9 slides up and down a yielding incline, 10, (see Fig. 5,) which keeps the dog *o* off of the paper; but upon the full upward movement being given to the bar *l* to effect the printing the pin 9 is moved up over the top of 10, and falls to the rear of said incline, bringing the dog in contact with the paper, and upon the full downward movement of the bar *m* the pin 9 slides under this incline 10, and the dog *o* feeds the paper forward the required distance. This incline 10 is at the outer end of an arm, 13, that is kept to the table *w* by the spring 14 so as to be raised by the pin 9 running beneath it, and then said pin 9 plays upon the surface of 10, keeping the dog *o* from contact with the paper while the type-wheel is being moved.

I claim as my invention—

1. The bar *p* and stops 5 and 6 to regulate the extent of motion allowed to the armature *c* of an electro-magnet, substantially as set forth.

2. A type-wheel rotated by a step-by-step motion and an impression-pad moved simultaneously, in combination with an electro-magnet and mechanism for regulating the extent of motion of the armature for moving the type-wheel or effecting the impression, substantially as set forth.

3. The yielding incline 10 and paper-feeding pawl *o*, brought into action by an increased movement of the armature of an electro-magnet, substantially as set forth.

4. An impression-pad moved by a spring to give the impression when the current is broken in an electro-magnet, in combination with a type-wheel, substantially as set forth.

Signed by me this 14th day of February, A. D. 1872.

T. A. EDISON.

Witnesses:

CHAS. H. SMITH,
GEO. T. PINCKNEY.

2 Sheets--Sheet 1.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,531. Patented May 7, 1872.

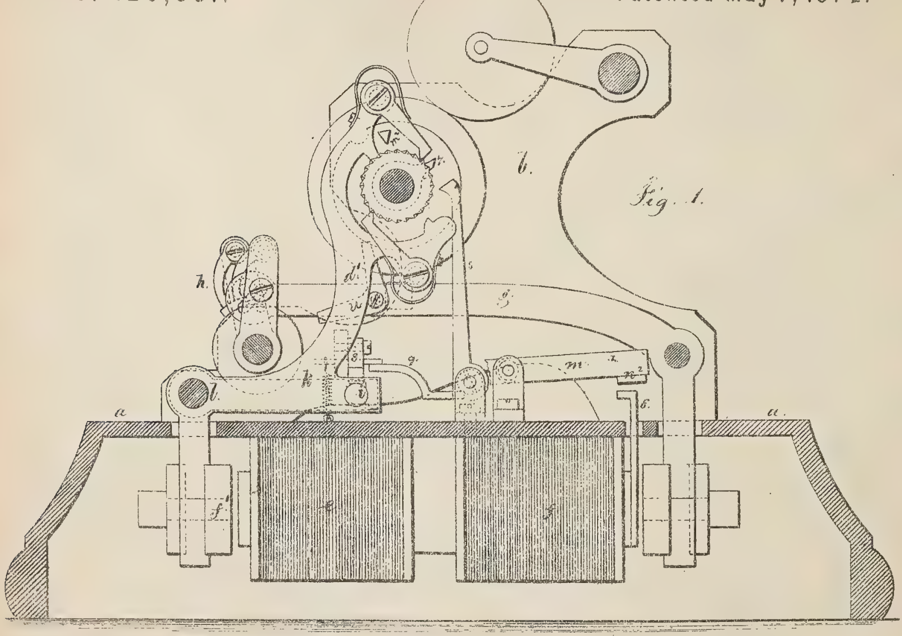


Fig. 1.

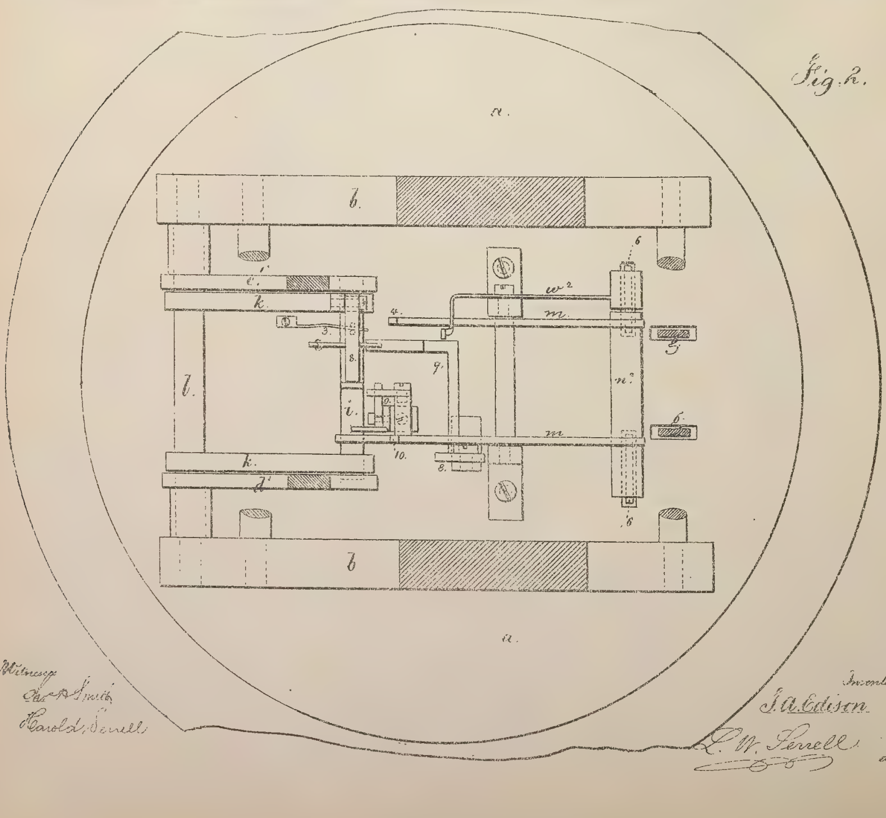


Fig. 2.

Witnesses
Chas H Smith
Harold Serrell

Inventor
T. A. Edison
L. W. Serrell atty

AM. PHOTO LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

2 Sheets--Sheet 2.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,531. Patented May 7, 1872.

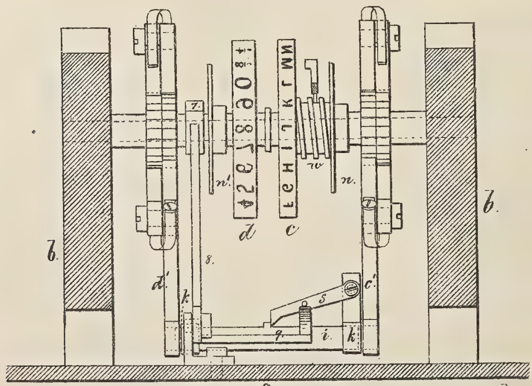


Fig. 3.

Fig. 4.

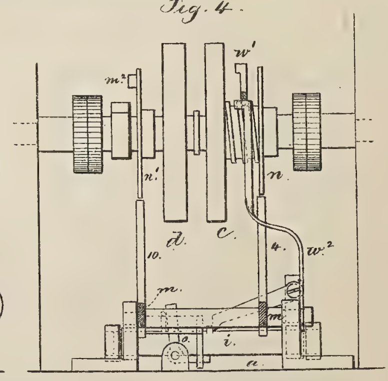
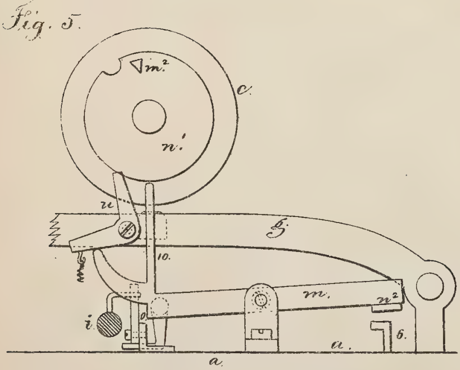


Fig. 5.



Witnesses,

Chas H Smith

Harold Serrell

Inventor

Thos A. Edison

L. W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,531, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs, and the following is declared to be a correct description of the same.

This invention relates to mechanism operated by the printing-lever or magnet for moving a bolt that connects the type-wheel lever with one of two levers that give motion to one of two type-wheels by a step-by-step motion. In my present improvement a lever is acted upon by lateral cores from the printing-magnet, and this moves a bolt endwise, and the same is held by a latch. This movement can only be given at the time both type-wheels are at the zero or unison-points. The type-wheel that is locked by the bolt is revolved, and, as it moves the last step, in completing the revolution, the latch is unlocked, and the bolt drawn by a spring to unlock the connection to one type-wheel and lock the lever to the other type-wheel, and that can be operated and impressions taken therefrom until the printing electro-magnet is charged at the zero-point of both type-wheels, when the said bolt is shifted to lock the other type-wheel.

In the drawing, Figure 1 is a section vertically of the machine. Fig. 2 is a sectional plan with the type-wheels removed. Fig. 3 is an elevation of the type-wheels, levers, locking-bolt, and latch. Fig. 4 shows the screw-unison for the type-wheel and the levers thereof; and Fig. 5 is a side view of the bolt-actuating lever.

The bed *a*, frames *b*, type-wheels *c d*, type-wheel magnet *e*, impression-magnet *f*, printing-lever *g*, paper-feeding clamps *h*, and roller are similar to devices shown in patents heretofore granted to me, with the exception that the type-wheels are separate from each other, and actuated by independent step-by-step movements; and I remark that this improvement may be used with one line-wire and a polarized switch be employed to direct the current into either of the electro-magnets. The armature f' and its lever *k* swing on the fulcrum *l*, and so also do the levers c' d', and between these and their respective type-wheel shafts or sleeves are the usual ratchet-wheels, pawls, and stops, forming step-by-step movements, to rotate the type-wheel. These may be of any desired character. I make use of a bolt, *i*, sliding in the lever *k*, and connecting either the lever c' or the lever d' to said lever *k*, and hence moving whichever lever is so connected, and also the type-wheel with which it is employed. The spring 3 moves the bolt *i* into the lever c', except when otherwise acted upon. Hence the letter-wheel *c* will be operated in the usual manner, and must be brought to a zero or blank before the bolt can be unlocked from c' and bolted into d'. To insure this, the disk *n* is employed, with one notch in it, into which the arm 4 of the lever *m* can pass; but, at other times, this lever *m* will be kept from moving by the arm 4 taking the edge of the disk *n*. The lever *m* is actuated by an armature, n^2, contiguous to lateral poles 6 from the printing-magnet *f*. When this lever *m* is allowed to move, it acts upon the right-angle lever *o*, and slides the bolt *i*, drawing one end out of the lever c', and entering the other end into the lever d', and in this position it is held by a latch, *s*. The other type-wheel, which is the figure or character-wheel *d*, is now locked, and can be moved step by step. Upon the sleeve of this type-wheel *d* is a cam, 7, that, as the type-wheel is moved its last step to the zero-point, acts upon the lever 8 and its arm 9 to lift the latch *s* and allow the spring 3 to throw the bolt *i* the other way. The cam 7 then clears the end of 8. Hence, if the printing-magnet is charged at this time, the levers *m* and *o* will again throw the bolt into d', but otherwise the letter-wheel *c* will be rotated. When the type-wheel *d* is being rotated the lever *m* will not be fully moved when the printing-lever is being moved by its magnet, because the end of the arm 10 will take against the edge of the disk n^1, and this disk n^1 is notched, and the notch comes opposite this arm 10 when the type-wheel is at the zero-point. The bent lever *u* upon the printing-lever *g* is moved by the lever *m*, and thrown into the path of the stud m^2 upon n^1, and this is located so as to be moved by that stud as soon as the type-wheel *d* is moved. Thereby the lever m' will be moved downward, and the arms 4 10 freed from the notches in *n* n^1 even if the armature should be attracted by any

lingering magnetism in the electro-magnet *f*. The screw *w* on the type-wheel shaft, stop-lever w^1, and relieving-lever w^2, actuated by the lateral core of the electro-magnet *f*, are substantially the same as the parts shown in an application heretofore made by me for a patent, and allowed.

I claim as my invention—

1. The lever *m* and armature n^2, contiguous to the lateral poles 6 of the printing-magnet, for actuating the bolt *i*, in combination with the arm 4 and disk *n*, substantially as set forth.

2. The disconnecting-lever 8, operated by the cam 7, in combination with the lever *m*, armature n^2, the latch *s*, bolt *i*, and levers for the respective type-wheels, the parts being arranged and acting substantially as set forth.

3. The bent-lever *u* on the printing-lever, in combination with the stop m^2, lever *m*, and armature n^2, substantially as set forth.

Signed by me this 17th day of January, A. D. 1872.

T. A. EDISON.

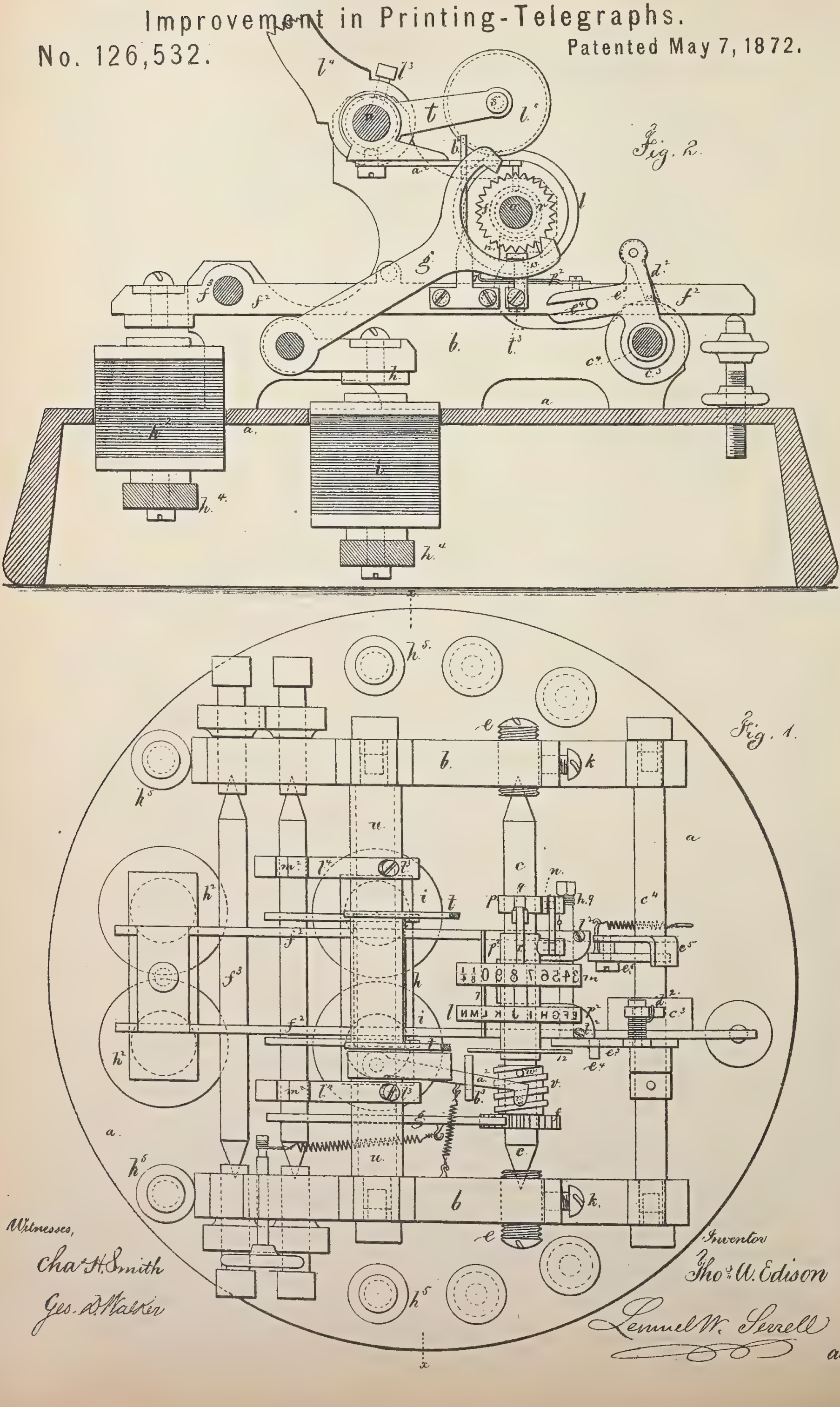
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets--Sheet 1.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,532. Patented May 7, 1872.



Witnesses,
Chas. H. Smith
Geo. D. Walker

Inventor
Thos. A. Edison
Lemuel W. Serrell
att.

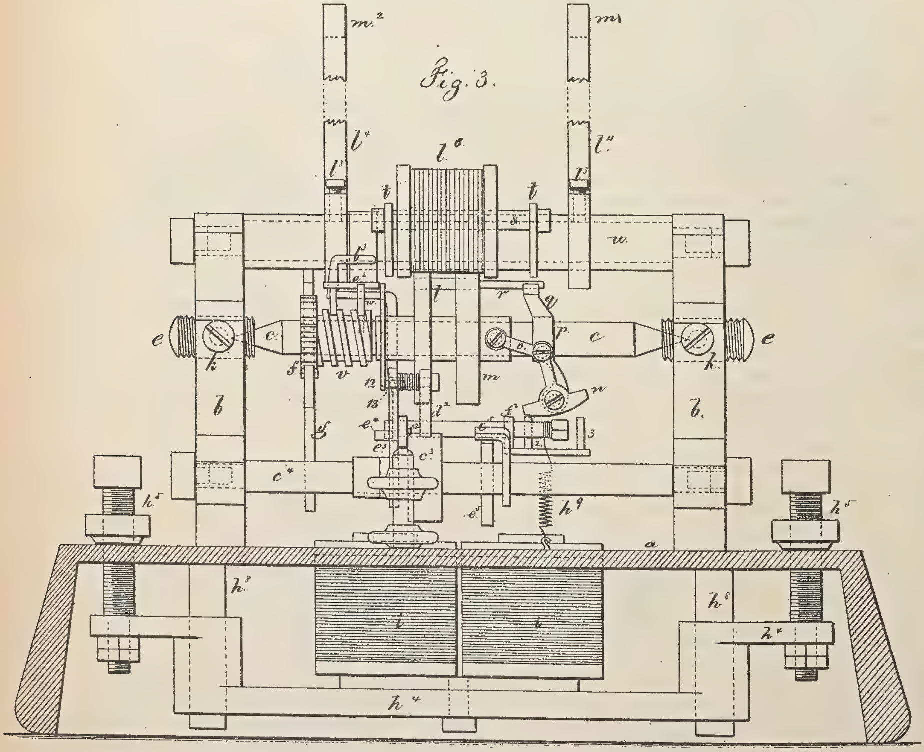
2 Sheets--Sheet 2.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,532. Patented May 7, 1872.

Fig. 3.



Witnesses,

Chas H. Smith

Geo. D. Walker.

Inventor

Thos. A. Edison

Lemuel W. Serrell

att'y

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,532, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made certain Improvements in Printing-Telegraphs, and the following is declared to be a full and exact description of the same.

In an application for Letters Patent dated July 26, 1871, and allowed August 18, 1871, a printing-telegraph instrument is shown in which two type-wheels are employed upon a revolving shaft, said type-wheels being upon a sleeve that slides upon the shaft, and is moved by a connection from the printing-lever to bring either type-wheel into position for printing. A shield between the paper and type-wheel is employed to prevent an impression from the type-wheel that is not in use.

In an application for Letters Patent dated November 13, 1871, and allowed December 15, 1871, a unison device is shown, consisting of a stop upon the type-wheel, a worm upon the type-wheel shaft, and a hinged and swinging arm, with one end resting on the worm, and operated by a connection to the impression-magnets, so that the swinging-arm is kept from contact with the stop upon the type-wheel except when these wheels are continuously turned for bringing all the machines in the line into unison, in which case the swinging arm comes into contact with said stop.

My present invention relates to modifications in the construction and arrangement of the parts employed in the before-named telegraph instruments, whereby the machine is rendered more compact, the parts adjusted with greater accuracy, and the working of the apparatus rendered reliable in all respects.

My improvements relate as follows: First, to the manner of mounting the type-wheel shaft in adjustable screw-bearings. Second, to shifting the type-wheels by a link and connections to the printing-lever. Third, to the ink-roller, made of disks of cloth or other woven material. Fourth, to the ink-roller fitted so that it can shift with the type-wheels. Fifth, to a pin inserted in the shaft to act as a stop for the unison arm to take against, instead of the stop being on the type-wheel. Sixth, to making the upper end of the unison tripper of a forked shape to limit the motion of the unison arm. Seventh, to the paper-feeding mechanism that operates upon the upward movement of the printing-lever, and a holding device to prevent back movement of the paper and allow of the printing being observed. Eighth, to the type-wheel and impression-magnets, sustained and adjusted with reference to their respective armatures. Ninth, to the arms for the paper-reels, affixed upon the cross-bar which sustains the ink-roller. Tenth, to the impression-shield, made as an open spring-plate to keep the paper in contact with the impression-pad and away from the type-wheel.

In the drawing, Figure 1 is a plan of the machine complete. Fig. 2 is a vertical section of the same; and Fig. 3 is an elevation of the apparatus with the bed in section at the line *x x*.

a is the bed of the machine, and secured to it are the side frames *b b*, of usual character. *c* is the type-wheel shaft, mounted in the screw-bearings *e e*, and revolved by the ratchet-wheel *f*, lever *g*, armature *h*, and electro-magnet *i*. The screw-bearings *e e* allow of the shaft *c* being adjusted longitudinally to accomodate the position of other parts; and to prevent the screws *e e* working loose by the jar or concussion of the apparatus I clamp them firmly by the screws *k k*, which enter the frames *b b* at right angles to the screws *e e*. The type-wheels *l m* are upon a sleeve sliding freely on the shaft *c*, and to shift said type-wheels so that either can be printed from I make use of the pins 2 3 upon the printing-lever to move the T-lever *n*. Instead of employing this T-lever to act by a slot and pin to move the sleeve as in the application for Letters Patent before referred to, I make use of a link, *o*, connected to the sleeve and lever *n*, by which a very easy motion is obtained, and one in which there is but little friction. The fulcrum of the lever *n* is upon an arm extending from the collar *p* upon the shaft *c*, and said collar is provided with a second arm, *q*, which acts as a guide for the pin *r* extending from the type-wheels, and insures the rotation of the type-wheels with the shaft *c*, and of their being kept in their proper position. The disk 12 and cam 13 prevent the type-wheels being accidentally shifted; these correspond to parts in before-named applications. The ink-roller l^6 is made

of a number of disks or washers of woven cloth, secured upon the hollow axis of the roller and between the heads thereof. The surface of the roller thus formed is dressed smooth by burning or otherwise, and such surface will wear smooth, and not become torn or injured by the sharp edges of the letters on the type-wheel, as is apt to be the case when the roller is formed of layers of cloth wound upon the axis of the roller. This roller is also much better than a roller formed of felt, because the fine fibers thereof are not closely connected together, and hence they wear off and clog the type-wheels. The ink-roller is upon the shaft *s*, that is supported by the arms *t t* from the cross-bar *u*, and I make this shaft *s* of such length that the ink-roller may slide upon the same as it is moved by and with the type-wheels as they are shifted, and thus prevent the type-wheels scraping the ink from the roller, as they now do with the fixed roller.

The "unison" device is a worm, *v*, upon the shaft *c*, a stop, *w*, projecting from the shaft *c*, a hinged and swinging arm, a^2, and the tripper b^3, connected to or moved with the printing-lever. The operation of this unison is the same as in the application before referred to, except that the tripper is moved by the printing-lever, instead of by the printing-magnet, to bring the arm a^2 to its normal position away from the stop *w;* but I make the upper part of said tripper-bar b^3 of the forked form shown, so as to limit the upward and lateral movement of the arm a^2 and keep it in its proper position relatively to the worm *v*. To feed the paper along I make use of the roller c^3 upon the stationary shaft c^4, the feeding-pawl d^2, the slotted lever e^3, and the pin e^4, on the printing-lever f^2. The printing-lever f^2 is moved by its magnet h^2, as usual; but the position of the slotted lever e^3 and pin e^4 is such that the feed of the paper takes place during the upward movement of the printing-lever by the direct action of the printing-magnet through the printing-lever, and not by the action of a spring, as is the case when the paper is fed by the downward movement of the lever; consequently this spring h^9 can be made lighter, and not so much power will be required to operate the printing-lever. Upon the shaft or bar c^4 is a stationary arm and plate, c^5, and connected to this arm is the spring-holding pawl e^5. The paper (one side of the strip) passes under this plate, and is prevented from moving back by the pawl e^5, and as this plate requires to be but very narrow, it does not hide the printing upon the strip of paper, but leaves it visible at this point. The printing and type-wheel magnets h^2 *i* are each mounted in and connected to a yoke or frame, h^4, and said frame is suspended and adjusted by the set-screws and nuts h^5 h^5. Guide-pins h^8 h^8 are employed for guiding and steadying the frame h^4. This arrangement allows of the magnets being adjusted to suit the position of their respective armatures. l^4 l^4 are arms secured to the bar *u* by the screws l^3 l^3, and formed at their upper ends with the bearings m^2 for the shaft of the paper-reel. The paper-reel thus located is not in the way of other parts of the machine, and avoids the use of a standard or support for the reel separate from the machine itself. The shield p^2, which prevents an impression from the type-wheel not in use, is a three-sided or open spring-plate, as shown in Fig. 1, and connected by the screws t^2 t^2 to the printing-lever. The paper passes from the paper-reel under the axis f^3 of the printing-lever, and thence beneath the rounded end 7 of said plate p^2 and over the impression-pad t^3, to the paper-feeding device, and this spring plate or shield keeps the paper in contact with the impression-pad and away from the type-wheel that is not in use; hence it prevents blurring of the paper by the type.

I claim as my invention—

1. The type-wheel shaft *c*, sustained at its ends in the screw bearings *e* that are clamped by the screws *k*, as specified.

2. The link *o* and T-lever *n*, in combination with the type-wheels *l m* and sleeve sliding on the shaft *c*, as set forth.

3. The inking-roller l^6, made of disks of woven cloth clamped between heads, as set forth.

4. The inking-roller sliding upon its shaft, in combination with the pair of type-wheels also sliding upon their shaft, as set forth.

5. The unison stop *w*, made of a pin passing into the type-wheel shaft, in combination with the worm *v* and swinging arm a^2, as and for the purposes set forth.

6. The unison tripper b^3, made as a fork, in combination with the arm a^2 and screw *v*, as and for the purposes set forth.

7. The paper-feeding mechanism, consisting of the dog d^2 and lever e^3, moved by the upward motion of the printing-lever and the holding-dog e^5, and acting near the respective edges of the paper, as set forth.

8. The type-wheel and impression-magnets, sustained and adjusted by the yoke h^4 and screws h^5 that pass up through the bed *a*, as set forth.

9. The arms *t* for the paper-reel, sustained upon and above the cross-bar *u* that receives the arms of the ink-rollers, as set forth.

10. The impression-shield, made as an open three-sided spring-plate, attached to the impression-lever, as and for the purposes set forth.

Signed by me this 3d day of January, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,533. Patented May 7, 1872.

Fig. 1.

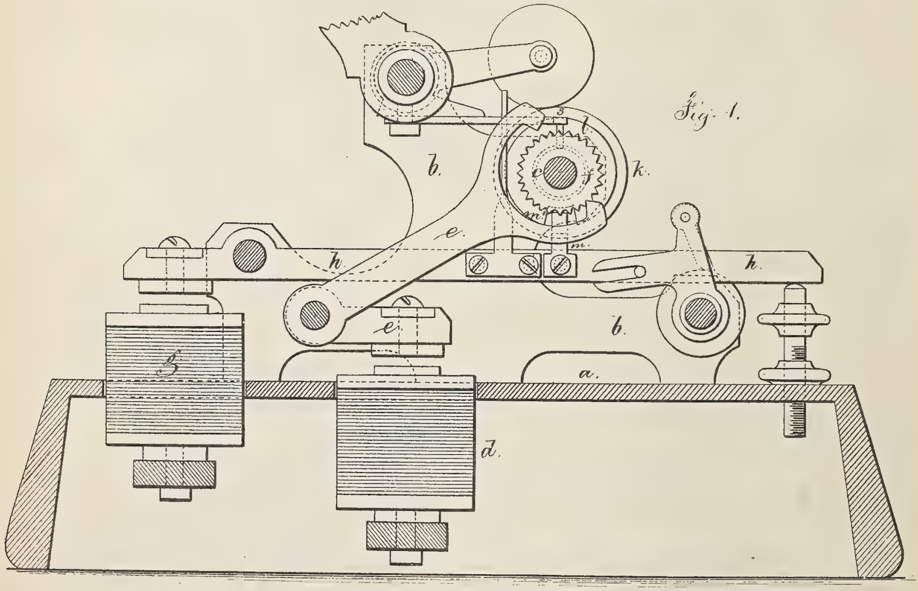


Fig. 3

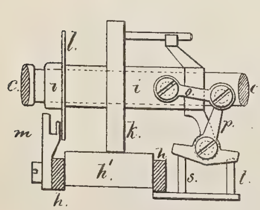
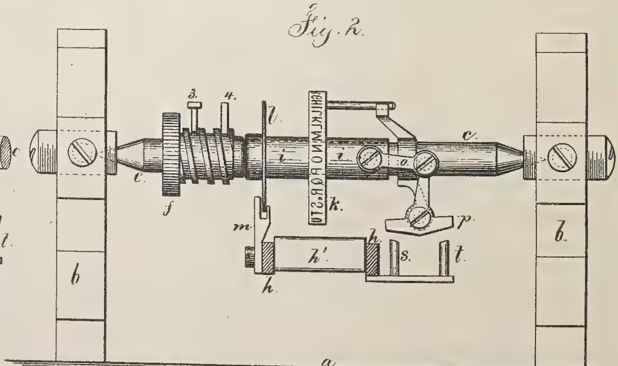


Fig. 2.



Witnesses

Chas H Smith

Geo. D. Walker

Inventor.

Thomas A. Edison,

Lemuel W. Serrell, atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,533, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have made a new and useful Improvement in Printing-Telegraphs; and the following is declared to be a full and correct description of the same.

This invention relates to a printing-telegraph instrument of the same general character as that set forth in an application for Letters Patent dated January 3, 1872; and this improvement consists of a locking device for preventing any instrument in the circuit receiving an impression of a message being sent except that one which the operator at the transmitting-station unlocks and brings into unison with his own instrument.

In the drawing, Figure 1 is a vertical section of a printing-telegraph instrument with my improvement applied. Fig. 2 is an elevation of the type-wheel shaft and its parts, together with a portion of the printing-lever, said parts being in position so that an impression cannot be made from the type-wheel; and Fig. 3 is an elevation of the same parts in position for printing.

a represents the bed, and *b b* the side frames of the machine. *c* is the type-wheel shaft, revolved by a step-by-step motion derived from the electro-magnets *d*, armature and lever *e*, and ratchet *f*. *g* are the electro-magnets for the impression-lever *h*. These parts are all of usual character, as is also the paper-feeding device. *i* is a sleeve sliding freely upon the shaft *c*, but turning with it, and secured to this sleeve is the type-wheel *k*, and also a disk, *l*, with one notch, *m′*, in its periphery. (See Fig. 1.) Upon the printing-lever *h* is an arm, *m*, and the upper part of this arm is made as a fork to receive the edge of the disk *l* when the parts are in the position shown in Fig. 2, and in this position an impression cannot be taken from the type-wheel, because the edge of the disk *l* acts as a stop to limit the movement of the impression-lever and prevent said lever and its pad *h′* rising high enough for that purpose. When the parts are in the position shown in Fig. 3 the disk *l* is free from the fork of *m* and the instrument is in condition for receiving and printing a message. The mechanical means for shifting the sleeve *i* and its disk and type-wheel are the same as in aforesaid application for shifting the sleeve and type-wheel, viz., by a link, *o*, connected at one end to the sleeve *i* and at the other end to a T-lever, *p*, pivoted to an arm on the type-wheel shaft; and this lever *p* is moved by the pins *s* and *t* on the printing-lever to shift the sleeve in either direction; but the shaft *c* has first to be rotated until the notch *m′* in the disk *l* coincides with the arm *m* before said sleeve can be shifted. This notch *m′* is differently located upon each instrument.

I will now proceed to describe the manner in which the operator at the transmitting-station unlocks the desired instrument in the circuit and brings the same in unison with his transmitting-instrument; but it is first to be understood that all the type-wheels *k* have the same letters and correspond with those on the transmitting-dial, and also that there may be as many instruments in the circuit as there are letters upon said dial, and that each machine is known by a particular letter. The operator, by pulsations sent through the magnets *d*, first rotates all the type-wheel shafts until each shaft is arrested in its revolution by the arm 3 and stop 4; but the type-wheels are not in unison with each other nor with the transmitter, but stop on different letters—one on A, another on B, another on C, and so through the alphabet. If the operator now desires to unlock the C machine, he turns the hand of the transmitting-dial until it is over the letter C, and then closes the circuit, through the magnets *g*, so as to throw up the printing-lever *h* and disconnect the arm 3 from the stop 4 of each instrument and allow all the type-wheels to be revolved, when pulsations are sent through the magnets *d*. There is sufficient space between the edge of the disk *l* and the bottom of the notch or fork *m* to allow of the limited movement of the printing-lever necessary to operate the arm 3, but not sufficient to allow of an impression being made. The C machine (the machine which stopped at the letter C) is now in unison with the transmitter, and to unlock said disk *l* from the notch of *m* it is necessary to turn the hand of the transmitter to that part of the dial which indicates that the notch in *l* is over and in line with the fork *m*. When the hand is brought to this point

the circuit is to be closed through the magnets *g*, which moves the impression-lever and brings the pin *s* in contact with the T-lever *p*, moving the same so as to slide the sleeve *i* and free the disk *l* from *m*. The machine is now in condition for receiving and printing a message. When this machine is no longer required for use the operator turns the hand of the transmitter to that point which indicates that the notch in *l* coincides with the fork *m*, and, by closing the circuit through the magnets *g*, the lever *h* is raised, and the pin *t* shifts the sleeve and disk, and the machine is again locked. I prefer that the sleeve *i* be shifted by the pin *s* to unlock the disk *l*, when the current is closed, through the type-wheel magnets *d*, and locked by the pin *t* when the circuit to said magnets is open. The disk *l* and type-wheel may be fixed upon the shaft and the stop *m* moved transversely of the printing-lever, the stops *s* and *t* projecting from the type-wheel shaft. The type-wheels might be all set at unison with each other, and the disk *l* and shifting devices changed to different positions, so that they all could be unlocked and the message sent to all the machines, which is not the case now.

I claim as my invention—

1. A locking mechanism, actuated by the movement of the printing-lever, for preventing an impression, in combination with the type-wheel and its actuating mechanism that controls the movement of the said locking mechanism.

2. A type-wheel and unison mechanism, in combination with a locking and unlocking mechanism for preventing or allowing an impression, substantially as specified.

Signed by me this 14th day of February, A. D. 1872.

T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

2 Sheets--Sheet 1.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,534. Patented May 7, 1872.

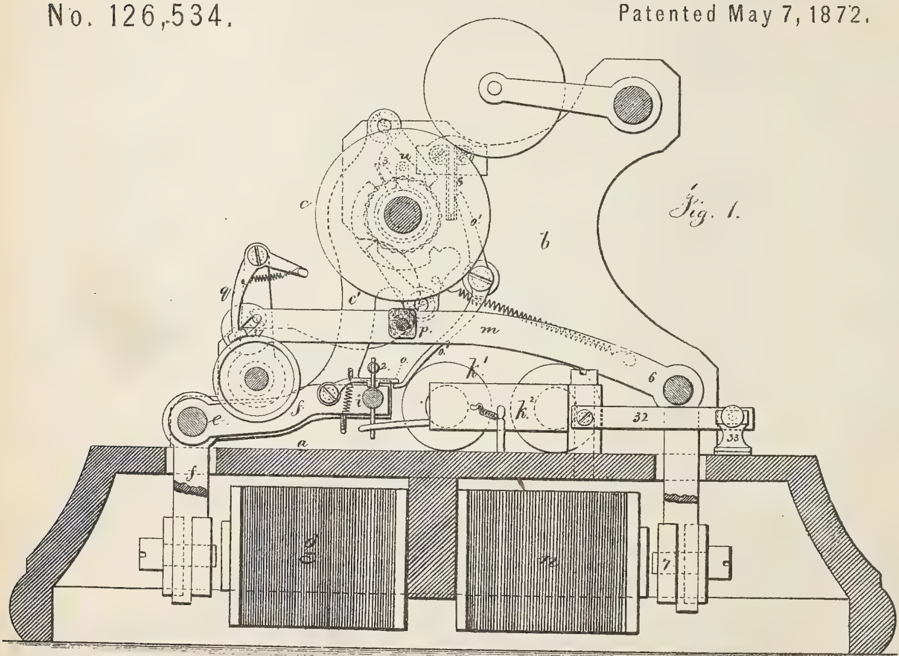
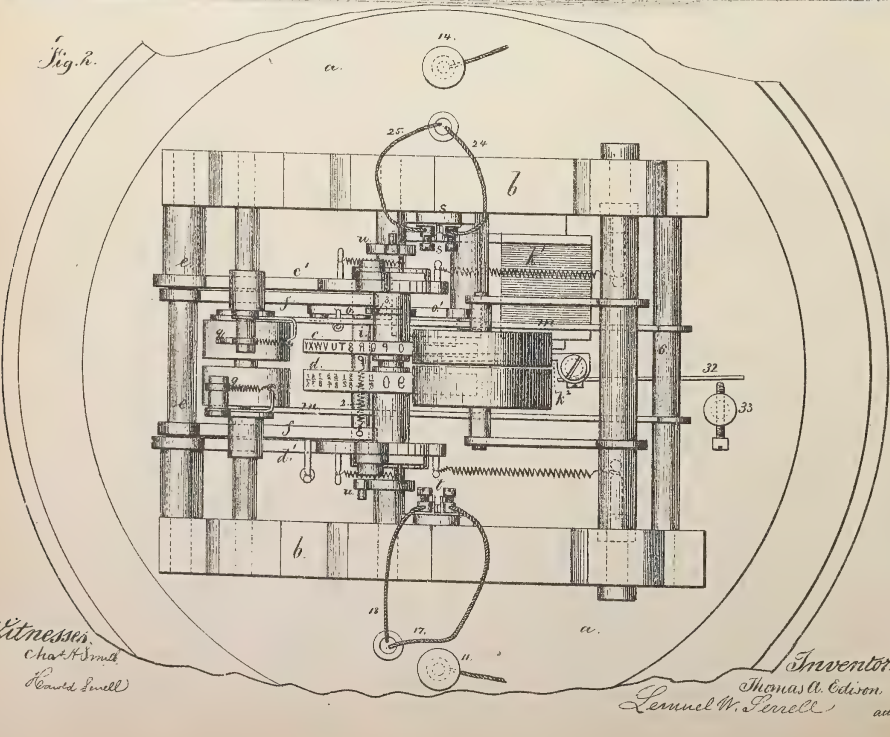


Fig. 1.

Fig. 2.



Witnesses:
Chas. H. Smith
Harold Serrell

Inventor.
Thomas A. Edison
Lemuel W. Serrell att'y

2 Sheets--Sheet 2.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,534. Patented May 7, 1872.

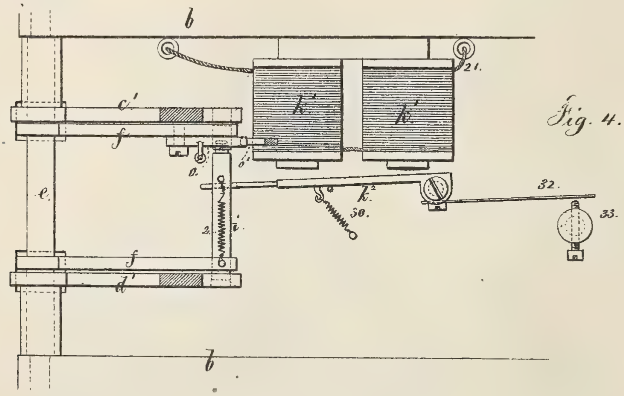
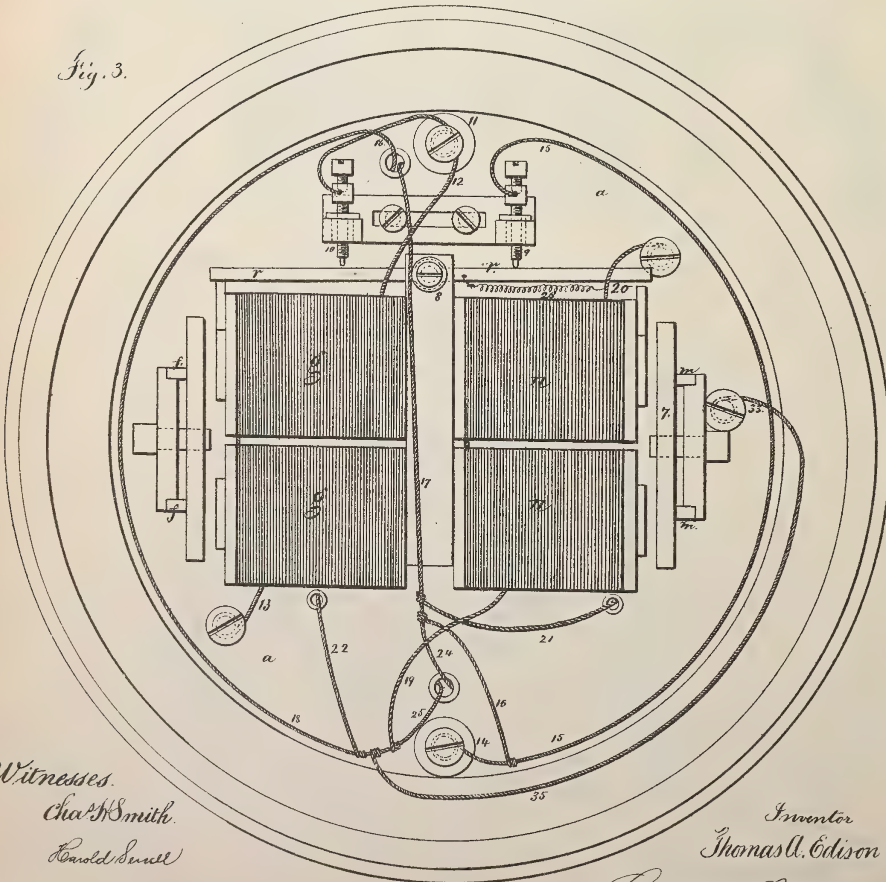


Fig. 4.

Fig. 3.



Witnesses.

Chas. H. Smith

Harold Serrell

Inventor

Thomas A. Edison

Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,534, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

This telegraph is made for printing from one of two type-wheels. The type-wheels are contiguous, and revolved by separate ratchets and pawls, or step-by-step motions, and a magnet is employed to operate a bolt that connects one of the step-by-step movements with the lever and armature of an electro-magnet, and a latch holds the parts thus connected. This latch is lifted every rotation of the locked letter type-wheel, hence is unlocked, and a spring causes the bolt to connect the armature-lever to the step-by-step motion of the number or character wheel, hence that will be rotated; but should it be desired to continue the rotation of the letter-wheel, a pulsation of opposite polarity operates in the impression-magnet, and through a connection to the locking-magnet, and relocks the letter-wheel and disconnects the figure-wheel. At all times, except when the letter and figure wheels are at the zero or nonus points, the locking-magnet is prevented from acting when an impression is made by a circuit-closer that gives a shorter and more direct route for the electricity, and hence cuts out the locking-magnet. This circuit-closer is opened by a non-conducting arm revolving with the type-wheel at the zero point.

In the drawing, Figure 1 is a vertical section of the instrument. Fig. 2 is a general plan. Fig. 3 is an inverted plan; and Fig. 4 is a plan of the locking-magnet, bolt, and levers.

Upon the bed *a* are the frames *b b*, sustaining a shaft that carries the type-wheels *c* and *d*, the type-wheel *c* having letters, and the wheel *d* figures and fractions, or other characters adapted to the use for which the instrument is intended. The lever *c′* is provided with the necessary pawls and stops to act upon the ratchet of the letter-wheel *c*, and move the same with a step-by-step motion, and *d′* is the lever, with similar devices to form a step-by-step motion for the figure-wheel *d*. These step-by-step motions, being of ordinary character, do not require further description. The levers *c′ d′* move upon a fulcrum or shaft, *e*, which is also the axis for the lever *f*, and armature of the electro-magnet *g*, designated herein the type-wheel magnet. The bolt *i* slides in the lever *f*, and when moved toward the lever *d′* by the spring 2, that end of the bolt *i* connects the lever *d′* with *f*, and they move together, and the lever *c′* is disconnected. When the bolt *i* is moved the other way the lever *d′* is disconnected from *f* and the lever *c′* connected by the other end of *i*, and in order to hold the bolt *i* a latch, *o*, is employed that springs into a notch in *i*. A lever, *o′*, beneath the end of the latch *o*, extends upward contiguous to a cam, 3, moving with the type-wheel *c*, so that at each revolution of *c* the latch *o* is lifted and the bolt *i* drawn from *c′* by the spring 2. The bolt *i* is moved toward *c′* by the armature *k* of the locking-magnet k^1. The printing-lever *m* moves upon the fulcrum 6, and carries the armature 7 of the printing-magnet *n*. The impression-pad *p*, feeding-clamps *q*, and actuating cam-slots 37 are of any usual character. The polarized circuit-changer *r*, swinging upon the fulcrum 8, and moved into contact with the circuit screw-connections 9 and 10, according to the polarity of the current, is substantially similar to devices shown in patents heretofore granted to me, in which the current is directed either through the printing-magnet or else through the type-wheel magnet, according to its polarity. The spring circuit-closers *s* and *t* are near the type-wheel shaft, and upon the sleeves or shafts of the respective type-wheels there are arms *u*, with non-conducting pins projecting from the sides, and passing in their revolution between the ends of the circuit-closing springs *s* or *t*, respectively, and opening them break the circuit, and these pins and arms are located so as to separate these springs *s t* when the type-wheels arrive at the zero points. The line-wires connect with the binding-screws 11 and 14.

The operation of this instrument is illustrated as follows: Suppose letter-wheel *c* at zero point and the circuit-springs *s* separated, and the bolt *i* connecting *f* and *d′*, the pulsation of electricity entering by 10 goes by wire 12 to magnet *g*; thence, by wire 13, to bed *a*, and by 8 and *r* through 9, wire 15, and to the line-screw 14. The pulsations, therefore, will act in the magnet *g* upon the step-by-step mo-

tion to set the wheel *d*. When the polarity of the current is reversed to effect the printing, the same enters at 14, passes through wires 16 and 17, springs *t*, wires 18 and 19, to the printing-magnet *n*; thence, by 20, to bed *a*, and by 8, *r*, and 10 to the line-wire from 11. To operate the letter-wheel *c* it is necessary to move the wheel *d* to the zero point, breaking the circuit at *t*; then reverse the pulsation, which then cannot go by 16, 17, 18, 19, &c., as before, because *t* is open; but it has to pass through 21 to the locking-magnet k', which throws the bolt *i*, unlocking d' and locking c'. The pulsation then goes, by 22, 19, through *n*, 20, *a*, 8, *r*, 10, and 11. The latch *o* holds the bolt *i*, and upon reversing the polarity of the current the letter-wheel can be moved around by the step-by-step motion and the printing done as before; but the pulsations in the type-wheel magnet pass from 11 through 12, *g*, 13, *a*, 8, *r*, thence by 9 and 15 to 14. When the impression is made on the letter-wheel *c* the pulsation comes through 14, 16, 24, 25, 19, *n*, 20, *a*, 8, *r*, 10, to 11, and if the letter-wheel *c* is to be revolved more than once, a reverse pulsation must be made upon the arrival of *c* at the zero point, because the cam 3 has in its last step unlatched *o* and allowed the spring 2 to draw the bolt *i* back from c'. This pulsation, as it cannot go through either *s* or *t*, has to go through the magnet k^1, and, by the armature k^2, move and relock the bolt *i* to c'. In order to prevent the armature k^2 remaining in contact with k^1 by any residual magnetism, I make the movement of the armature close the circuit between 32 and the insulated screw 33, so that there is a connection made from 22 through 35, 33, 32, to the bed *a*. The circuit at 32 33 is again broken as the armature is drawn back by the spring 30. A fine wire, 36, between *r* and 20, prevents the circuits being broken if the polarized switch *r* should not touch either 9 or 10. The locking-magnet k^1 might be operated by a separate line-wire; and either of the circuit-springs *s* or *t* may be employed with the pin on the type-wheel shaft for cutting out an electro-magnet, or compelling the circuit to pass through the same when the non-conducting pin intervenes between the springs.

I claim as my invention—

1. Two type-wheels, actuated by separate levers and step-by-step movements, in combination with an actuating electro-magnet, armature, and bolt that locks either of the levers with the actuating-armature, substantially as set forth.

2. An electro-magnet for operating the locking-bolt, in combination with the said levers, step-by-step movements, and type-wheels, substantially as set forth.

3. The latch *o* for holding the bolt *i* unlatched by the cam 3 upon the type-wheel shaft, in combination with the armature and levers to actuate the type-wheels, substantially as set forth.

4. The circuit-closing springs *s* or *t*, separated by the non-conducting pin upon the type-wheel shaft, in combination with an electro-magnet for directing the pulsation through that magnet when the pin is between the springs, substantially as specified.

5. The arrangement of circuit-connections, substantially as set forth, for actuating either of three electro-magnets in one main telegraph line, for moving one of two type-wheels and effecting the printing, substantially as set forth.

Signed by me this 17th day of January, A. D. 1872.

T. A. EDISON.

Witnesses:

Geo. D. Walker,
Geo. T. Pinckney.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,535. Patented May 7, 1872.

Fig. 4. Fig. 1.

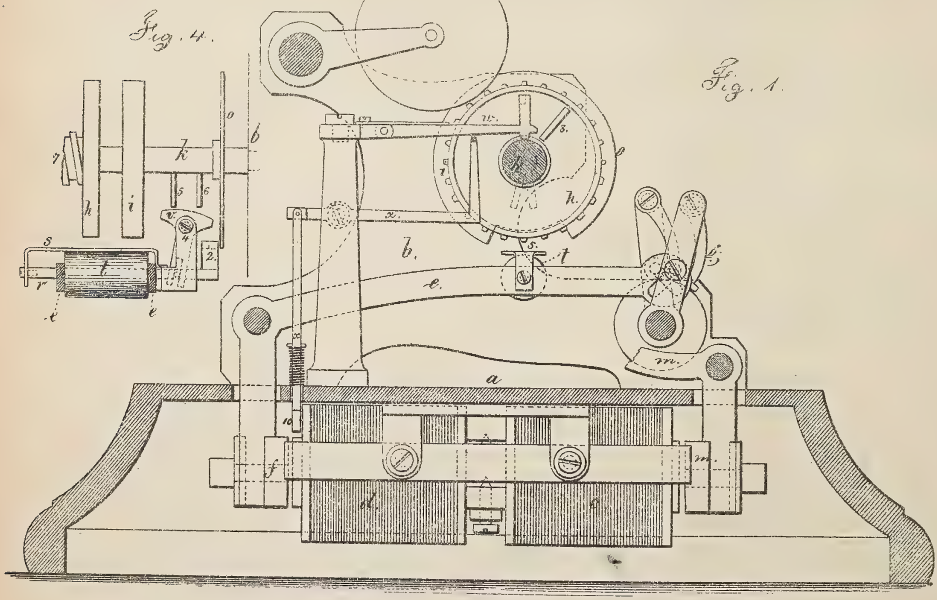


Fig. 3.

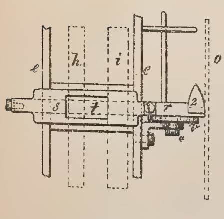
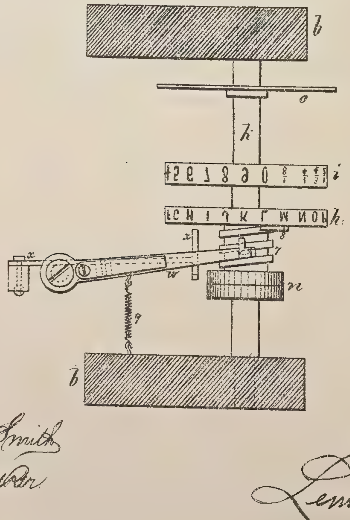


Fig. 2.



Witnesses. Chas H Smith

Geo. D Walker

Thos. A. Edison

Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,535, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

In my present invention I make use of two type-wheels, revolving with their shaft, and employ an impression-pad with a sliding shield, in which is an opening. This shield can be changed at certain points in the rotation of the type-wheel, so as to allow the impression to be made from one of the type-wheels through the opening in the shield, while the other is prevented from impressing the paper by the intervening shield. I also make use of an unison mechanism that is brought into action by two or more rotations of the type-wheels, but thrown out of action by the act of moving the pressure-lever or charging its magnet. By this means, if pulsations are sent through the line sufficient to rotate the type-wheels twice or more times without an impression being taken, the type-wheels will be moved around until the stop is operative, and then the same will be stopped and the pulsations may be continued, for the purpose of bringing into unison other type-wheels, in the same electric current, that may not be correctly set; and as soon as the circuit is reversed, or the impression or other magnet charged, all the unison devices in the circuit are simultaneously liberated; and this unison mechanism is not operative each rotation of the type-wheel; hence, as an impression is usually made each rotation, or nearly so, of the type-wheel, the unison mechanism will not come into play except when the rotation is continued for effecting that unison.

In the drawing, Figure 1 is a vertical section of my instrument. Fig. 2 is a plan of the type-wheels and unison; Fig. 3 is a plan of the pad and shield; and Fig. 4 is an elevation of the device for moving said shield.

The bed *a*, frames *b b*, type-wheel magnet *c*, impression-magnet *d*, and the connections to the main line are to be of any desired character; and where the printing-magnet is made operative by reversing the polarity of the current, the devices for directing said current may be such as shown in patents heretofore granted to me. The impression-lever *e*, armature *f*, and feeding-clamps *g*, for the paper, may also be of any desired character. The type-wheels *h i* are upon the shaft *k*, and they are moved by a step-by-step movement actuated by the armature *l* and lever *m*. *n* is the ratchet-wheels for the pawls on the lever *m;* these parts do not constitute any part of my present invention. Upon the shaft *k* is a disk, *o*, revolving with such shaft, and notched at one side; and upon the impression-lever is a slide, *r*, carrying the shield *s* above the pressure-pad *t*. Upon the end of the slide *r* is a cam, 2, that can pass through the notch in the disk *o;* but this can only be done when the type-wheel is at a certain point; hence the shield *s* will be held by this cam and slide, with the opening in such shield under one or other of the type-wheels. A T-shaped lever, *v*, is mounted upon a pivot, 4, upon the lever *e*, and, by a slotted end, acts upon this slide *r;* and there are two pins, 5 and 6, projecting from the shaft *k* and contiguous to this T-lever *v*, so that, if the impression-lever is moved when one pin, 5, is over said lever *v*, the slide and shield will be moved one way; and if the type-wheel is turned one space further, so as to bring the other pin, 6, over this lever *v*, the movement of the slide and shield will be the other way; hence the operator can bring the shield so as to print from one wheel or the other by simply rotating the type-wheels around to the proper point, and then giving motion to the impression-lever. There is a screw-thread, 7, upon the shaft *k*, and a tooth upon the lever *w* takes therein; there is also a block or stop, 8, upon the type-wheel. The spring 9 draws the lever *w* away from 8 each time the tooth is lifted out of the screw 7; hence, according to the number of turns of the screw-thread so the type-wheels will have to be rotated before the end of the lever *w* will be brought up far enough to arrest the stop 8; and each time the lever *w* is raised, it is drawn back to the beginning of the screw-thread; hence, if there is a connection between *w* and the impression-lever, or the impression-magnet, the stop 8 and lever *w* will not come into contact when the instrument is being employed in printing; but when the pulsations are contin-

ued through the type-wheel magnet, all the type-wheels in the circuit will be stopped at the same point, as before mentioned. The lever *x* and armature 10 at the side of the core of the magnet, form a convenient means for lifting the lever *w* and its tooth out of the screw 7; and this may be made to operate by a feeble pulsation, so as not to move the impression-lever.

I claim as my invention—

1. The sliding shield actuated by the T-lever *v* and pins 5 and 6, on the shaft *k*, in combination with the two type-wheels, substantially as set forth.

2. The revolving disk *o* and the cam 2, in combination with the shield *s* and type-wheels, substantially as set forth.

3. A unison stop actuated by a screw upon the type-wheel shaft, substantially as set forth.

4. The lever *x* and armature 10, at the side of the core of the magnet *d*, in combination with the unison-lever *w*, for moving the same, substantially as specified.

Signed by me this 13th day of November, A. D. 1871.

T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 128,604. **Patented July 2, 1872.**

Fig. 2.

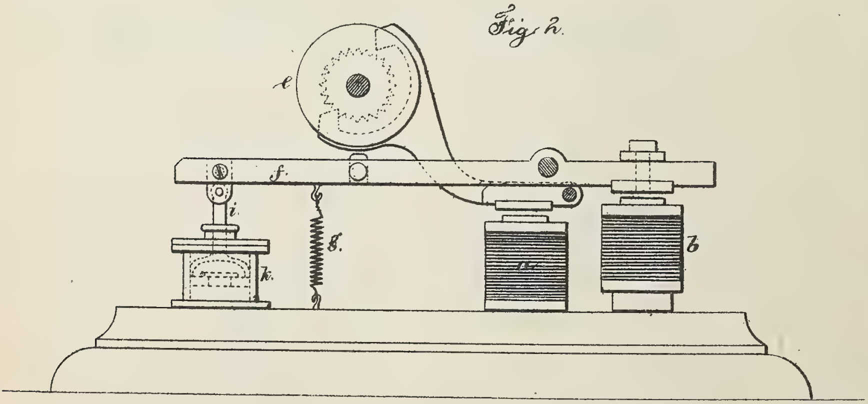
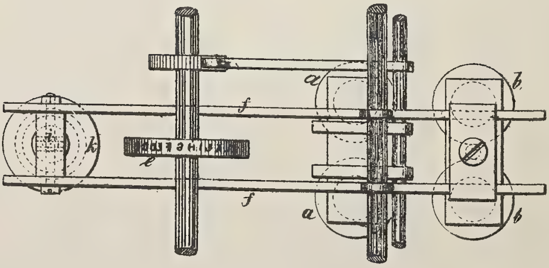


Fig. 1.



Witnesses.
Chas. H. Smith
Harold Serrell

Inventor
Thos. A. Edison
Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 128,604, dated July 2, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description thereof.

This invention relates to combining with the printing-lever an air-cushion that acts as a detainer to the printing mechanism so as to prevent it operating, except after the type-wheel has been set by the pulsations in the main line, and the circuit is kept closed while the air-cushion is sufficiently displaced to permit the impression.

In the drawing, Figure 1 is a plan, and Fig. 2 an elevation, of this improvement.

The type-wheel magnet *a* and printing magnet *b* are in the same electric circuit. The pulsations in the magnet *a* operate to set the type-wheel *e* by a step-by-step movement, but they do not move the impression-lever *f* sufficiently for printing, because the spring *g* is acting upon the same, and the air-cushion in the cylinder *k* formed between the piston and said cylinder arrests any sudden movement, and the spring *g* acts between the pulsations to keep the piston from gradually forcing the air out of the cylinder *k;* but when the circuit is kept closed at the transmitting station the printing-lever *f* is allowed to move and give the impression as the rod *i* moves the piston and displaces the air-cushion sufficiently to allow of this movement. The piston may have a valve to open as the lever descends, so as to allow the printing-pad to move rapidly away from the type-wheel.

I claim as my invention—

The air-cushion applied to and combined with the printing-lever and its magnet in a printing-telegraph instrument, in the manner and for the purposes specified.

Signed by me this 26th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 128,605. Patented July 2, 1872.

Fig. 2.

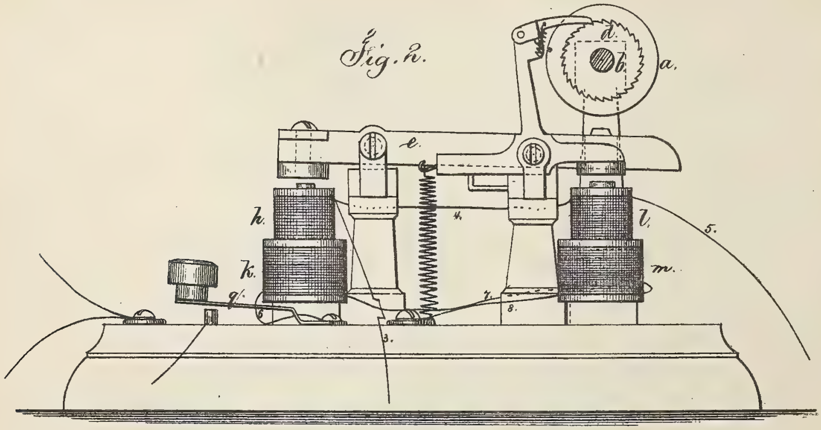
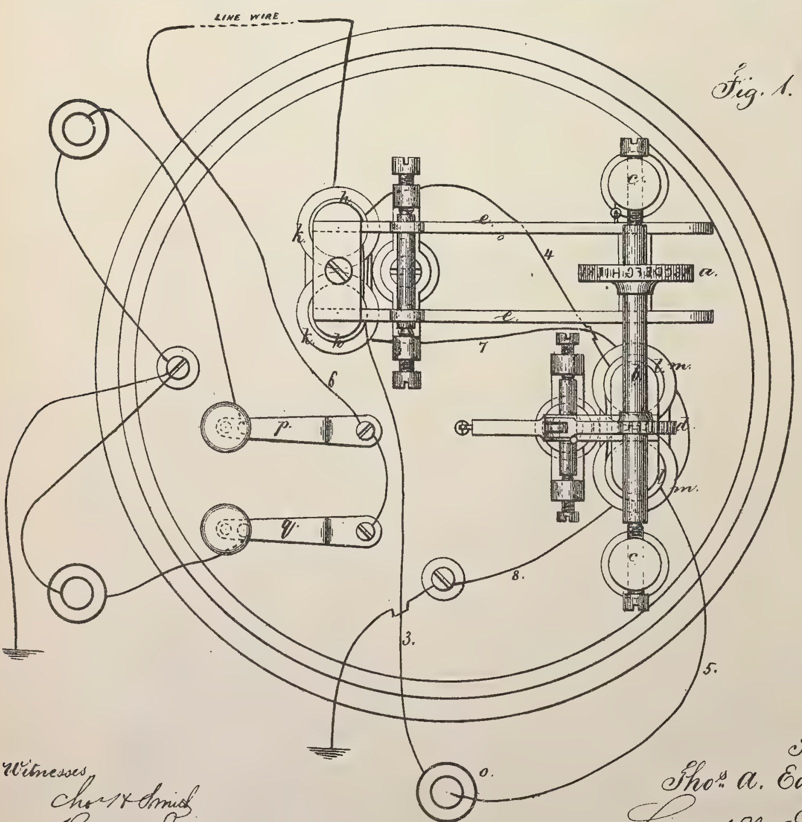


Fig. 1.



Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thos. A. Edison,
Lemuel W. Serrell
atty.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 128,605, dated July 2, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is a correct description thereof.

This instrument is provided with two compound magnets—one to move the type-wheel, the other to move the printing-lever. One spool of each magnet is in a local constant circuit, and the other spools or helices are in the main line, and these are wound so that a positive current on the main line neutralizes the magnetism from the local constant battery in the printing-magnet and intensifies the magnetism in the type-wheel magnet; hence the type-wheel can be set by a current of one polarity, and, when the polarity of the main-line current is reversed, the magnetism in the type-wheel magnet is neutralized, and that in the printing-magnet intensified to give the impression.

In the drawing, Figure 1 is a plan of the instrument, and Fig. 2 is a side view with one of the standards or frame removed.

The type-wheel *a* on the shaft *b*, supported in the frames or standards *c*, is to be revolved by a step-by-step motion applied to the ratchet-wheel *d*, and the impression is given by the printing-lever *e;* and I remark that these parts may be of any desired character, as my invention may be employed with single or compound type-wheels and with any desired step-by-step movement. The printing-magnet is composed of the usual cores within the double spools or helices *h k*, and the type-wheel magnet is also compound, having the helices *l m*. The helices *h* and *l* are in a local constant circuit, 3 4 5, from the battery *o*, and the helices *k m* are in the circuit 6 7 8 connected to the main line. The keys or pulsators *p* and *q* may be of any desired character, such as a transmitting-dial, or other means for making and breaking the main-line circuit.

The parts are arranged and the helices wound so that when a current of one polarity is sent over the main line the printing-magnet will be inoperative, in consequence of the current in the helices *k* tending to produce polarity in the cores the reverse of that produced by the constant circuit in the spools *h*. At the same time the type-wheel magnet will be sufficiently energized to overcome its resistance or spring, in consequence of the current in both helices *l m* producing the same polarity in the cores; but when a pulsation of the opposite polarity is sent the type-wheel magnet will be inoperative, and the printing-magnet energized to give the impression.

In this manner a printing-telegraph instrument can be operated by one line-wire without any switch or polarized circuit-changer, the local constant battery being employed with each instrument.

I claim as my invention—

The compound type-wheel magnet and the compound printing-magnet in a printing-telegraph instrument, in combination with a local constant circuit connected to one set of spools in such magnets, and the main-line current connected to the other spools of such magnets, to be operated substantially in the manner and for the purposes set forth.

Signed by me this 26th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 128,606. Patented July 2, 1872.

Fig. 2.

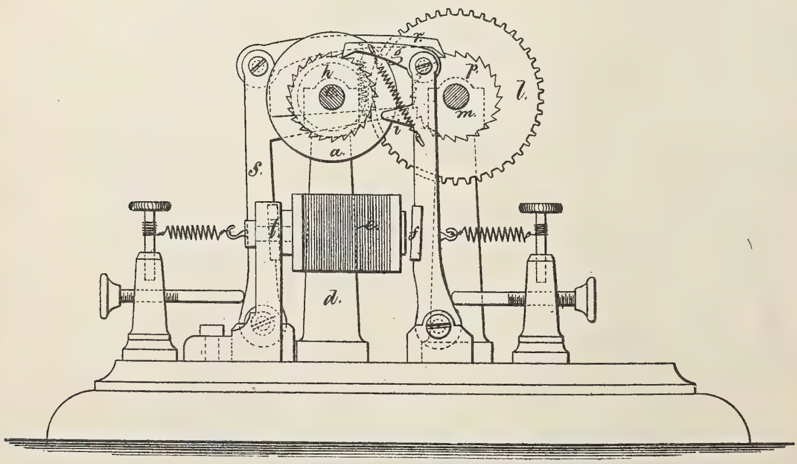
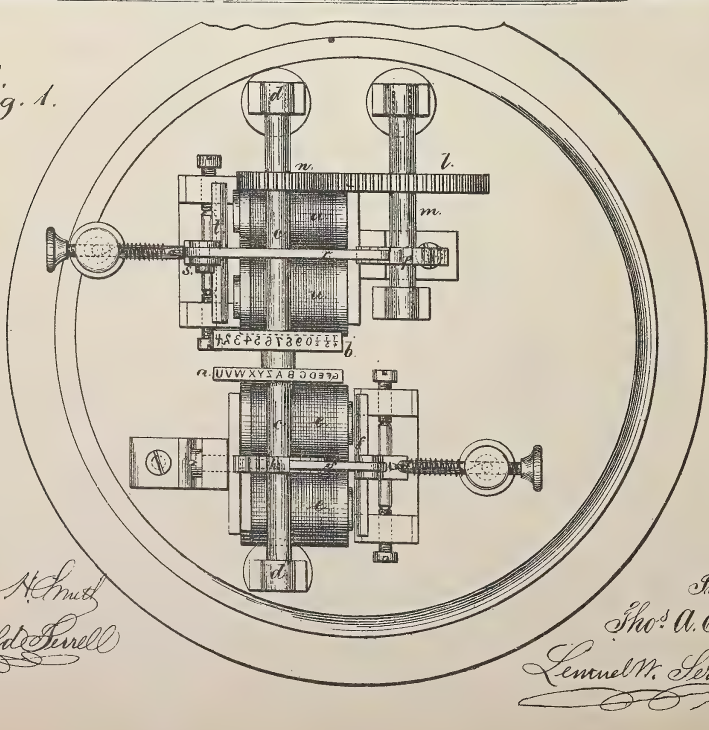


Fig. 1.



Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thos. A. Edison
Lemuel W. Serrell atty.

128,606

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 128,606, dated July 2, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs; and the following is declared to be a correct description thereof.

In printing-telegraphs considerable time is lost in actuating the step-by-step movement, because there is no opportunity to move the type-wheel more than one letter at a time.

My invention is made to promote rapidity in actuating the type-wheel. Said invention consists in a multiplied motion from a step-by-step movement applied to the type-wheel, so that one pulsation on the line will give a motion to the type-wheel equal to two or more letters. The parts are constructed and arranged so that either the multiplied movement can be given, or the single step-by-step motion, according to the letter to be brought into position for printing.

In the drawing, Figure 1 is a plan of my instrument, and Fig. 2 is an elevation of the same.

The type-wheel *a* and figure-wheel *b* are shown as upon the shaft *c*, sustained in suitable frames or bearings *d*, and I remark that these type-wheels may be of any desired character, and either single or double, and the impression mechanism may be of any available character. The magnet *e*, armature *f*, pawl *g*, ratchet *h*, and stop *i* are of any ordinary or desired character, and act to move the type-wheel around one letter at a time by a step-by-step movement. The gear-wheel *l*, upon the shaft *m*, takes into the pinion *n* upon the type-wheel shaft *c*, and these two gears are proportioned so that the wheel *l* contains, say, six times the number of teeth in the pinion; thereby the type-wheel will be revolved six times for one revolution of the shaft *m*. Upon this shaft *m* is a ratchet-wheel, *p*, operated by the pawl *r*, lever *s*, armature *t*, and magnet *u*. If the ratchet-wheels *h* and *p* have the same number of teeth, and the proportion of gearing aforesaid was used, then for each pulsation in the magnet *u* the type-wheel will move six letters or spaces, and complete a revolution in either four or five pulsations of the magnet *u*, according to the number of characters upon such type-wheels. In this manner great rapidity can be obtained, because the long intervals and numerous pulsations required between impressing one letter and the next are lessened. The magnet *u* may be energized by a reversal of the current operating in the magnet *e*, or by a separate line-wire. The transmitting dial or instrument may be of any desired character adapted to these two magnets, and the currents to them.

I claim as my invention—

A type-wheel in combination with two actuating magnets and connections, substantially as set forth, one for operating a step-by-step motion one letter or division at a time, and the other for moving the type-wheel two or more letters or divisions at a time, substantially as specified.

Signed by me this 26th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 128,607. Patented July 2, 1872.

Fig. 2.

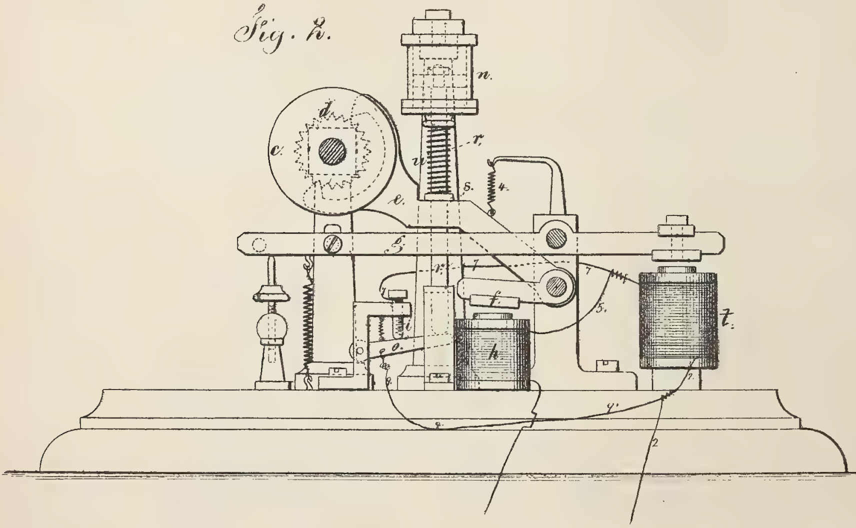
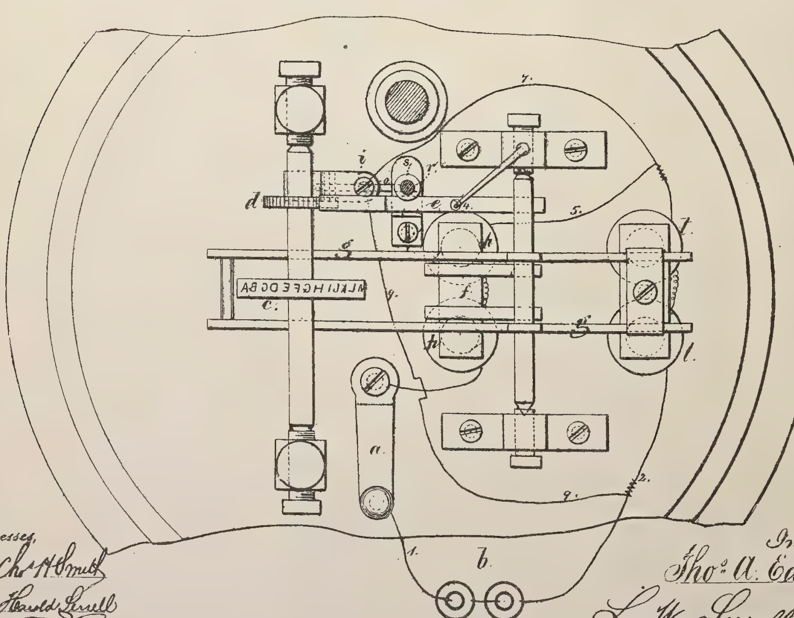


Fig. 1.



Witnesses,
Chas H Smith
Harold Serrell

Inventor
Thos A. Edison
L. W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 128,607, dated July 2, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

In this instrument the magnet that gives the impression is in the main-line circuit as well as the type-wheel magnet, but the former is "cut out" by a shunt or short circuit that is closed when the instrument is not working, and during the pulsations that set the type-wheel; but when a pause occurs with the circuit closed this short circuit is broken by a gradually-operating spring or weight controlled by an air-cushion, so that the electricity is forced to pass through the printing-magnet and gives the impression, simply in consequence of keeping the circuit closed when the letter to be printed has arrived in position for the impression.

In the drawing, Figure 1 is a plan, and Fig. 2 an elevation, of the instrument.

The finger-key *a* is introduced to illustrate any suitable apparatus for opening and closing the electric circuit from the battery *b*. 1 represents the line-wire, and 2 the ground or return circuit. The type-wheel *c* is moved by any suitable step-by-step motion. I have shown the ratchet-wheel *d* and lever *e*, operated by the armature *f* and spring 4. The printing-lever *g* may also be of any desired character. The type-wheel magnet *h* is connected with the line-wire 1, and from this the wire 5 leads to the printing-magnet *t*, and thence the circuit returns by the wire 2. If this alone was used, both magnets would be energized each pulsation; therefore, to prevent this, I employ the short circuit or shunt, composed of the wire 7 leading to the screw *i*, and the wire 9 leading to the tongue *o*. The air-cushion is made of the cylinder *n*, within which is a piston, and the rod *r* of the same rests at its lower end upon the tongue *o*, and the parts are adjusted so that the circuit between *i* and *o* is closed when the parts are at rest, because a collar, *s*, on the rod *r* rests upon the type-wheel lever *e* and holds the rod *r* up against the spring *u*. When the type-wheel lever *g* is vibrated in setting the type-wheel, the movement is sufficiently rapid to keep pressing the rod *r* up against the action of the spring *u*, and the air-cushion prevents its return with rapidity; but when a pause takes place in the pulsations, and the circuit is kept closed, the rod *r* descends and moves the tongue *o*, breaking the shunt-circuit through 7, *i*, *o*, and 9, and compelling the electricity to pass through the magnet *t* and produce the printing. The parts return to the position of inactivity with magnet *t* cut out by the circuit 7 *i o* 9, when the circuit is broken at the transmitting station, and I remark that there might be a finger upon the printing-lever *g* to lift the rod *r*, in which case the impression-lever would drop back instantly, as the circuit would be closed again through 7, *i*, *o*, and 9; and in this manner a second or third impression of the same letter, number, or character would be given by keeping the circuit closed at the transmitting station to allow sufficient time for the rod *r* to descend again and open the shunt at *o i*.

I claim as my invention—

Two electro-magnets, one for operating the type-wheel lever, the other for giving the impression, both in the main circuit, in combination with a "shunt" or "cut-out" circuit and a shunt-breaker, substantially as and for the purposes set forth.

Signed by me this 26th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Printing-Telegraph Instruments.

No. 128,608. Patented July 2, 1872.

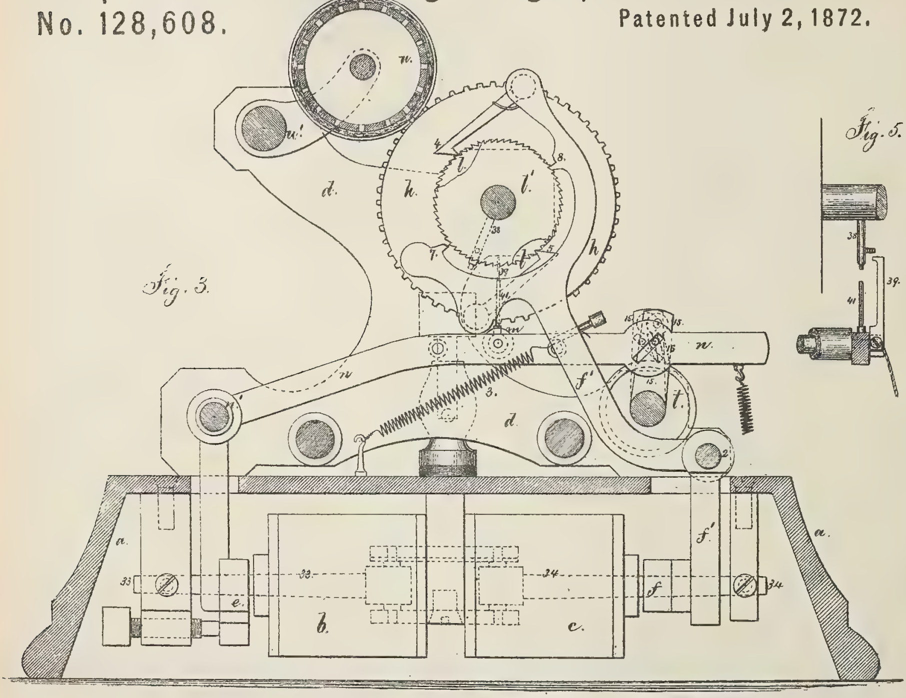


Fig. 3.

Fig. 5.

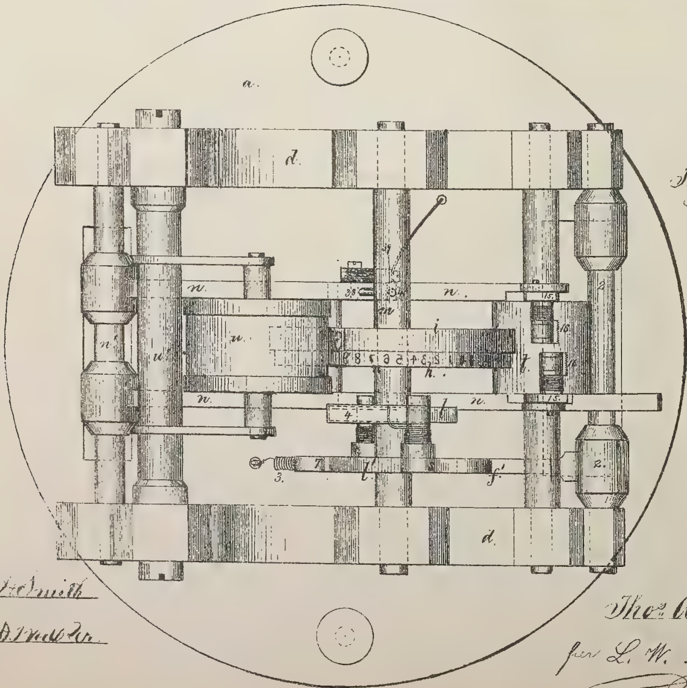


Fig. 1.

Witnesses.

Chas. H. Smith

Geo. D. Walker

Thos. A. Edison,

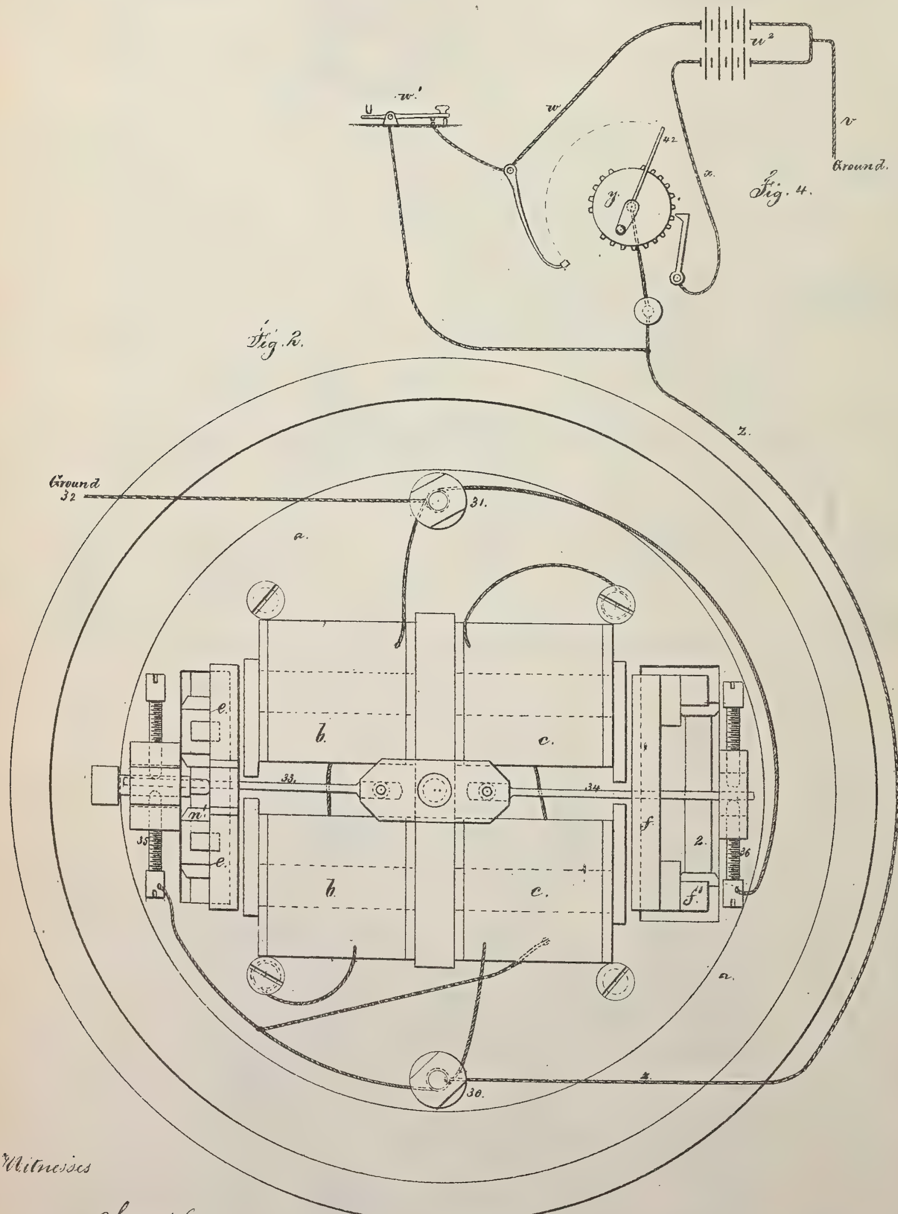
per L. W. Serrell

2 Sheets--Sheet 2.

T. A. EDISON.

Improvement in Printing-Telegraph Instruments.

No. 128,608. Patented July 2, 1872.



Witnesses

Chas. H. Smith

Geo. D. Walker.

Thos. A. Edison

per L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. 128,608, dated July 2, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made a new and useful Improvement in Printing-Telegraphs, and the following is declared to be a correct description thereof.

Printing-telegraphs have been constructed to work upon a single wire by means of two electro-magnets and one polarized magnet, so combined with each other that a current of one polarity is made to act upon one electro-magnet and an opposite current upon the other magnet by arranging cut-offs upon the electro-magnets and rendering them active or inactive, as the case may be, by the polarized magnet. My present invention consists of a compound electro-magnet, constructed in such a manner that when a current of one polarity enters both parts of the magnet the polarity of the current acting upon the devices of the compound magnet determine which part shall become active or magnetic, thereby dispensing with a third magnet. In this manner two operations, distinct from each other, can be performed with the use of only one line-wire. I also provide a unison connection, so that the act of transmitting pulsations from the sending station can be availed of to set all the type-wheels of the several instruments placed in one electrical circuit at a zero-point at each complete revolution of the type-wheel, thereby insuring accuracy in transmission in consequence of the frequent unison action.

In the drawing, Fig. 1 is a plan. Fig. 2 is an inverted plan. Fig. 3 is a vertical section, and Fig. 4 is a diagram illustrative of the connections.

The base *a* contains within it the compound magnet *b c*, and upon said base are the frames *d*, carrying the respective shafts and axes. The part *b* of the compound magnet acts upon the armature *e* of the printing and paper-feeding mechanism, and the portion *c* acts upon the armature *f* and lever *f'* to operate the type wheel. The type-wheel is made of two rings upon arms, the one ring *h* having figures, signs, or fractions, and the other ring, *i*, has letters or similar characters, so that either one or the other can be printed at will, because the characters on one wheel come opposite a blank space on the other wheel, as illustrated in the drawing, in which the figures and fractions come between the terminal letters of the alphabet, facilitating the construction and setting of the wheel, and allowing the letters to be printed on one line and the figures and fractions on another, and there is a portion of the type-wheel where there are not any characters, and at this part the unison connection is made to operate. The lever *f'* is on a fulcrum, 2, and the spring 3 acts to draw the armature from the magnet when the electrical circuit is broken. The lever *f'* has arms carrying the spring-pawls 4 and 5, that have hooked ends acting upon the wheel *l* so as to move the said wheel *l* one tooth at each vibration of the lever *f'*, the pawl 4, upon the return movement of the armature, giving a partial movement to the type-wheel so as to insure the catching of the pawl 5 over the next foot and lessen the amount of play of the escapement-lever. The lever *f'* has stop-spurs, 7 and 8, acting with the reverse ratchet-teeth of the wheel *l'* to check the movement and prevent the momentum carrying the type-wheel more than one letter at a time. The stop-spurs 7 and 8 are arranged so that the holding-faces are at right angles to lines drawn from the center of motion 2, so that the locking will be of the most reliable character, there being no tendency to move the spurs by the concussion of the wheel against them in stopping.

The printing or impression is effected by the pad *m* upon the lever *n*, that is mounted upon the axis or fulcrum *n'* and actuated by the armature *e* to the magnet *b*. The paper is fed along by the movement of the impression-lever. The roller *t* is mounted upon an axis that has upon each side of the roller sleeves that carry crank-arms 15 and spring-pawls or points 16, and in the ends of the two portions of the lever *n* that pass contiguous to these arms 15 are diagonal slots placed in opposite positions and taking pins that project from the arms 15, so that as the lever *n* rises one pawl, 16, will

bind the paper to the roller t and carry both forward, and the other pawl will be drawn back, so that as the lever n descends the first-named pawl 16 is drawn back and the other pawl made to operate in feeding the paper. Thus the paper can be moved along with facility, as there are two movements to each impression of the letter or type; consequently but one-half the motion of the lever is required as would be the case if only one feed-pawl was used. The ink is supplied to the types by means of a hollow perforated drum, u, or roller, into which the ink is introduced, and around this roller a cloth or felt surface is attached, as seen in Fig. 3, to rest upon the types of the type-wheel. The ink gradually passes through the perforations and the surrounding cloth, and thus the quantity necessary for the types is furnished. The roller u is upon arms swinging upon the shaft u^1, so that the ink-roller lies constantly in contact with the type-wheel. The connections for the compound magnet are illustrated in the plan, Fig. 2; and diagram, Fig. 3. The battery at u^2 is divided, a connection, v, passing from near the center to the ground. The wire w passes to the finger-key w', and from the other end of the battery the wire x passes to the transmitting instrument y; thence to the line-wire z, uniting with a wire from the finger-key and passing to the binding-screw 30 of the instrument. The wire z passes from the binding-screw 31 of one instrument to the screw 30 of the next, and so on through as many instruments as there are in the line, and then connecting to the ground at 32, beyond the last instrument. Between the helices b b and c c of the compound magnet are steel tongues 33 34, hinged at one end and swinging freely horizontally. The polarity of b and c will, with a positive current, attract by means of the arms at the ends of the soft-iron magnet the tongue 34 to the circuit-closer 36, and repelling the tongue 33 from 35. By changing the currents the reverse movements take place of the tongue. The transmitting-dial y is made in any usual manner, so as to give the pulsations through the wire z and screw 30, and the current being positive the compound magnet as charged connects 34 and 36 and breaks 33 and 35 by the reversed polarity; hence the current will be directed through the helices c, the base-plate forming a part of the circuit, to operate the type-wheel by the armature f and lever f'. The current passes from the helix c to the bed a of the instrument; thence through the tongue 34, (which is in metallic contact with the base,) circuit-closer 36, to the screw 31 of the line or ground wire, returning by 32 and v. If the finger-key w' is closed when the circuit through y is broken the direction of current is instantly changed and the compound magnet b c is altered in its polarity, 34 and 36 separating and 33 and 35 closing, so that the magnet b is made fully operative to effect the printing; the current passing from 31 to the magnet b, thence to the base a, switch 33, closer 35, binding-screw 30, to the key w', and battery, and vice versa.

In order to insure unison of movement in the type-wheels of several machines in one line or circuit, I provide two or more blank spaces on each type-wheel, and employ an arm, 38, on the type-wheel shaft, which, when a given one of these blank spaces is opposite the impression-pad, comes in contact with the insulated circuit-closing spring 39, so that a direct current passes through this spring, the type-wheel shaft, and the bed of the machine instead of the magnet c; hence the magnet ceases to be operative, although the current proceeds to other machines and operates upon the same, bringing them to the same position should they not be in that position. Upon reversing the current through w' the impression-magnet b operates the lever n, lifts the spring from contact with the arm 38, breaking the current through 39, and simultaneously the stud 41, coming against the end of the arm 38, prevents the movement of the lever n sufficiently to impress or feed the paper; the spring 39, being slightly under strain by the arm 38, clears the same, as the parts resume their normal position. These parts are shown more clearly in Fig. 5.

By having an arm upon the transmitting instrument, as shown at 42, and locating the same so as to close the circuit between w and z, at the period in the rotation of the dial when the machines are to be brought to a normal position, the machinery becomes self-operating without the use of the finger-key, and applies a correcting movement to all the type-wheels in the electrical circuit every rotation of the type-wheel, hence insuring great accuracy.

I do not claim a hollow perforated inking-drum, as the same is shown in the patent of S. S. Laws, No. 99,273.

I claim as my invention—

1. A compound magnet provided with steel tongues that direct the force of the electrical current through one portion of the magnet or through another portion, according to the direction in which the current passes to said compound magnet, substantially as specified.

2. The double-acting pawls 4 5, stops 7 8, and lever f', combined with the ratchet and type-wheel, as set forth.

3. Two type-wheels on one shaft parallel to each other, and arranged so that the blank spaces upon one wheel come opposite to the characters on the other, and vice versa, substantially as set forth.

4. The hollow perforated inking-drum surrounded with a surface of fibrous material, and arranged so that the said surface is in contact with the type-wheel, as and for the purposes specified.

5. The pawls 16 16, and crank-arms actuated by the lever *n* to feed the paper, in the manner specified.

6. The arrangement of the magnets that operate the type-wheel and printing mechanism within the bed of the machine, as set forth.

7. The circuit-closing spring 39 and arm 38, arranged, substantially as set forth, to stop the action of the magnet *b*, for the purpose of bringing several machines in one main circuit into unison, substantially as set forth.

8. The combination of the compound magnet, the type-wheel, and actuating mechanism with the printing and paper-feeding mechanism, substantially as set forth.

Signed this 24th day of May, A. D. 1870.

THOMAS A. EDISON.

Witnesses:

HAROLD SERRELL,

GEO. T. PINCKNEY.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 128,131. Patented June 18, 1872.

Fig. 3.

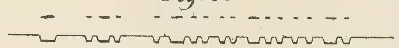


Fig. 2.

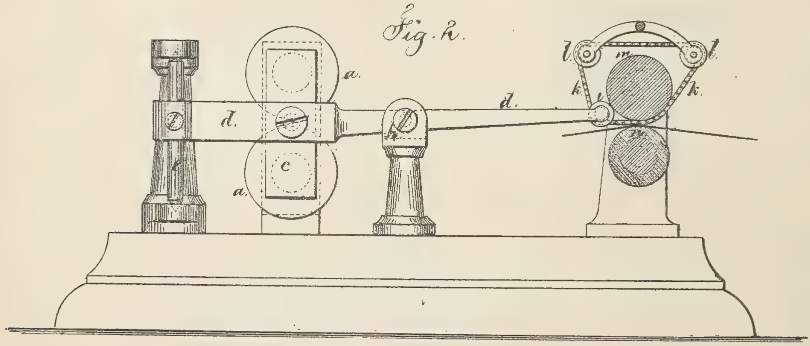
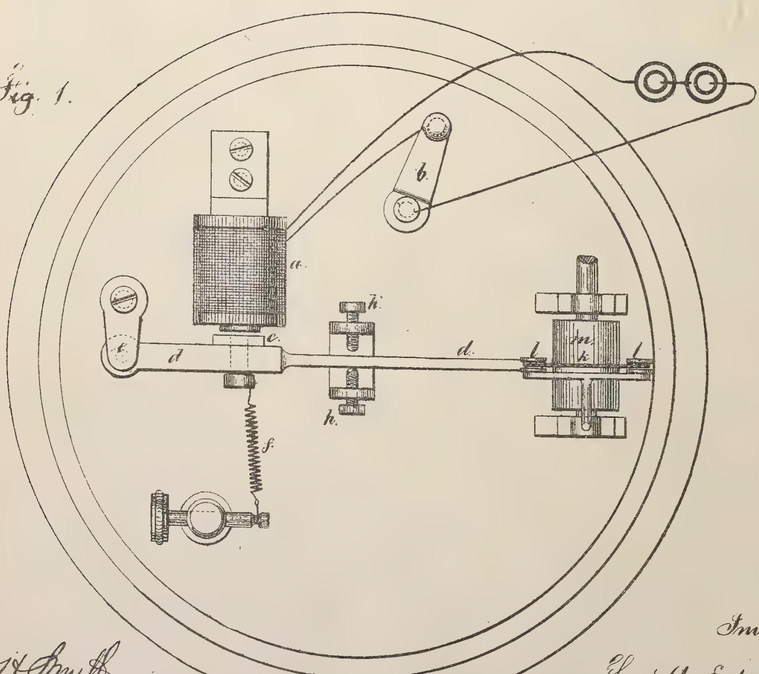


Fig. 1.



Witnesses

Chas. H. Smith

Harold Serrell

Inventor

Thos. A. Edison.

Lemuel W. Serrell

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 128,131, dated June 18, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Magnetic Telegraphs, and the following is declared to be a correct description of the same.

The ordinary magnetic telegraph is provided with a lever and point, the latter being held in contact with the paper to make a mark therein. In this case the magnetic energy must be sufficiently powerful to give the required pressure of the point on the paper.

My invention is made for giving a record by embossing the paper in a waving or zigzag line, by pressure between a rigid and an elastic roller, by means of a cord or chain that is positioned by the action of an electro-magnet. When the magnet is not charged the cord or chain will give a straight embossed mark; when the magnet is energized by a short pulsation the cord or chain will be moved out and back to produce a short undulation or V-formed embossing; and when the pulsation is longer the undulation will be of greater length, thus indicating dots and dashes. A comparatively feeble current can be employed, and yet the embossing will be so bold that the communication might be read by the touch, or the strip of paper might be used in an automatic machine to actuate mechanism for printing or otherwise preparing the message for delivery, a device for this purpose being contemplated by me.

In the drawing, Figure 1 is a plan, and Fig. 2 an elevation, of the apparatus, the rollers being in section.

The electro-magnet *a* is of any usual character, and is energized by pulsations in an electric circuit. The finger-key *b* illustrates the means for opening and closing this circuit. The armature *c* swings with the lever *d* upon the fulcrum *e*, and is retracted by the spring *f*, or drawn back or repelled in any suitable manner. The amount of motion to the lever *d* is determined by the screw-stops *h*. At the end of the lever *d* is a small roller, *i*, or opening, through which passes the endless chain or cord *k*, that is suspended or guided by the rollers *l*, and passes through between the rollers *m* and *n*. These rollers *m* and *n* are revolved constantly, while the machine is in action, by any suitable mechanism, and the roller *n* should have an elastic covering, and the paper pass in between said roller *n* and the chain or cord *k*. As the rollers *m n* revolve and draw the paper along, the chain *k* will emboss or indent the paper in a straight line; but when the magnet *a* attracts the armature the chain will be drawn off and produce a zigzag line, as shown in Fig. 3, the long undulations representing dashes and the short ones dots, as indicated by the corresponding line of telegraphic characters.

I claim as my invention—

A chain or cord under control of an electro-magnet, and pressed into contact with the surface of the paper to produce a telegraphic character by embossing, substantially as set forth.

Signed by me this 26th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Electro-Magnets.

No. 130,795. Patented Aug. 27, 1872.

Fig. 2.

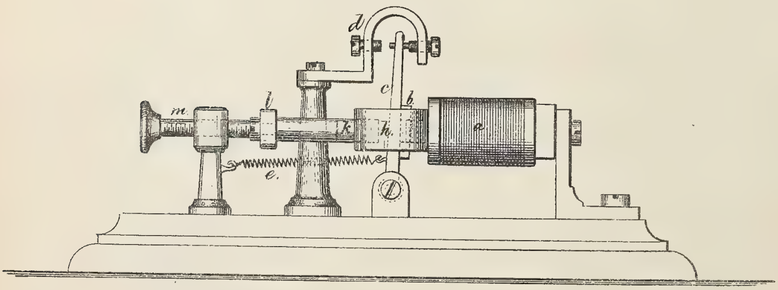
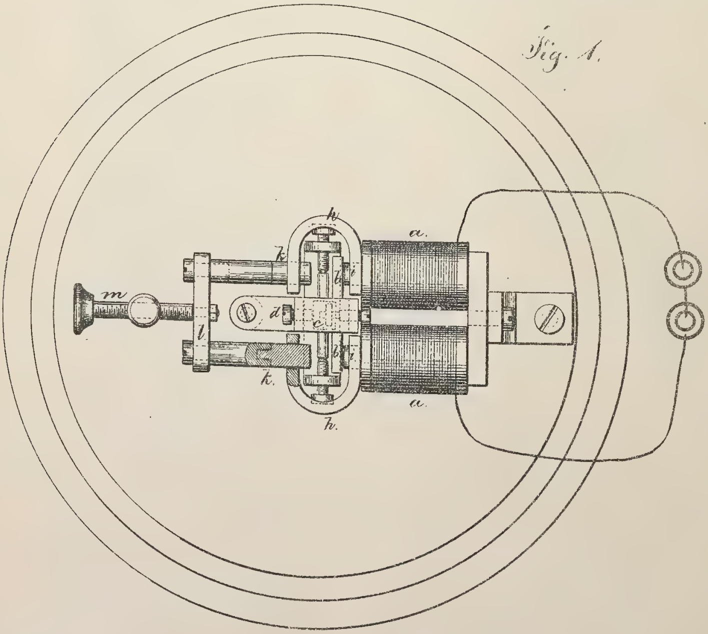


Fig. 1.



INVENTOR

Chs. H. Smith

Thomas A. Edison,

Geo. D. Walker

Witnesses.

Per L. W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN ELECTRO-MAGNETS.

Specification forming part of Letters Patent No. **130,795**, dated August 27, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Electro-Magnets; and the following is declared to be a correct description of the same.

If two magnets of equal power act in opposite directions and at the same distance from a swinging armature, said armature will not be moved; but by removing one magnet further from the armature the other will be free to exert on that armature a force equal to the difference between the effective force of one magnet and the other. I avail of the foregoing features, and, instead of employing an adjustable spring to draw the armature back, I use a weight or spring of uniform power, and I provide a balancing-pole energized by induced magnetism from the core of the electro-magnet, and use an adjustment, so that the power of the electro-magnet and the induced magnet are balanced in their action on the armature; thus, when the electro-magnet is energized by a powerful current the induced magnetic pole will act with a proportionate power in the opposite direction, or may be adjusted so as to leave only sufficient surplus of force in the electro-magnet to overcome the spring or weight; hence the armature will respond very rapidly, because the opposing forces neutralize each other instantly upon the circuit through the electro-magnet being broken.

In the drawing, Figure 1 is a plan, and Fig. 2 is a side view, of this improvement as applied to a relay-magnet.

The electro-magnet *a* is of usual character. The armature *b* is shown as on the swinging lever *c* that opens and closes the local circuit at *d*, and a spring or weight at *e* acts to draw back the armature. These parts are to be of any usual or desired character, according to the work for which the instrument is to be employed. The iron yokes *h* are connected with the cores *i i* of the electro-magnets, and they extend around to the balancing-poles *k k* that pass through these yokes, and are made of iron, and hence are magnetized with the same polarity as the cores *i i* by induction. These poles *k* are to be adjusted to stand at the proper distance from the back of the armature, and for this purpose any suitable means may be employed—such as the cross-bar *l* and screw *m*—which must not be of iron, or the proper polarity of the poles *k* would be interfered with.

It will be apparent that the attraction of the poles *k* is acting up the armature *b* in the opposite direction to that of the cores *i*, hence that the relative distance of the poles from the armature must be such that the proper force will be exerted to move the armature when the electro-magnet is energized. If the current is powerful the poles *k* should be closer to the armature, and if feeble the poles should be further removed.

I claim as my invention—

The balancing-poles *k*, energized by induced magnetism from the cores *i* of the electro-magnet, and acting in opposite direction to such electro magnet, substantially as set forth.

Signed by me this 9th day of May, 1872.

T. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Rheotomes or Circuit-Directors.

No. 131,334. Patented Sep. 17, 1872.

Fig. 2.

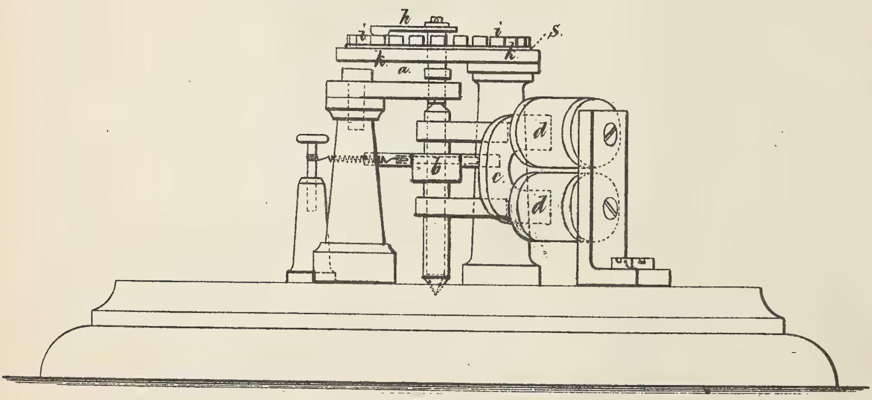
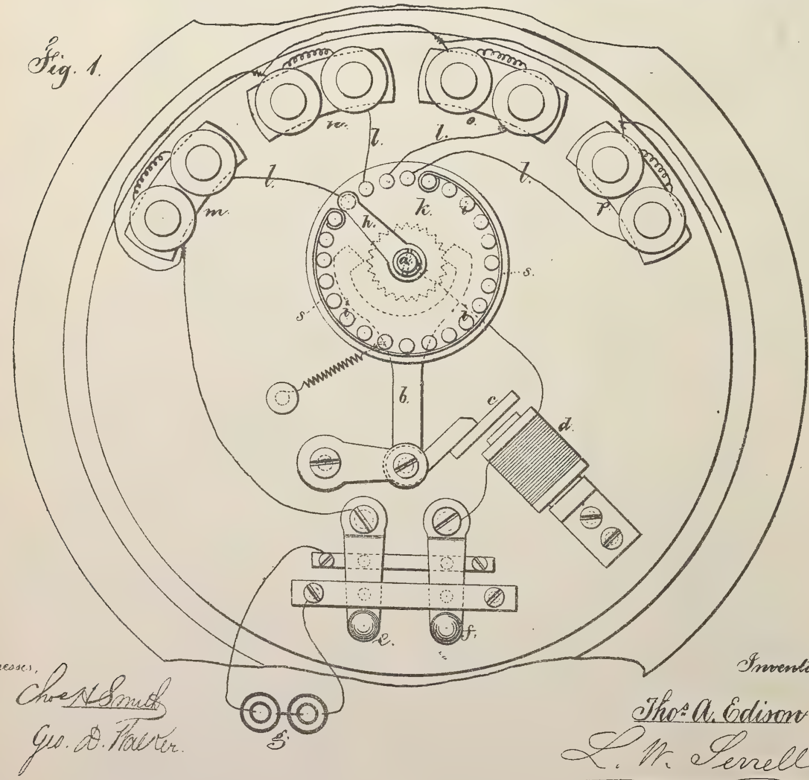


Fig. 1.



Witnesses,
Chas H Smith
Geo. D. Walker.

Inventor,
Thos A. Edison,
L. W. Serrell
atty.

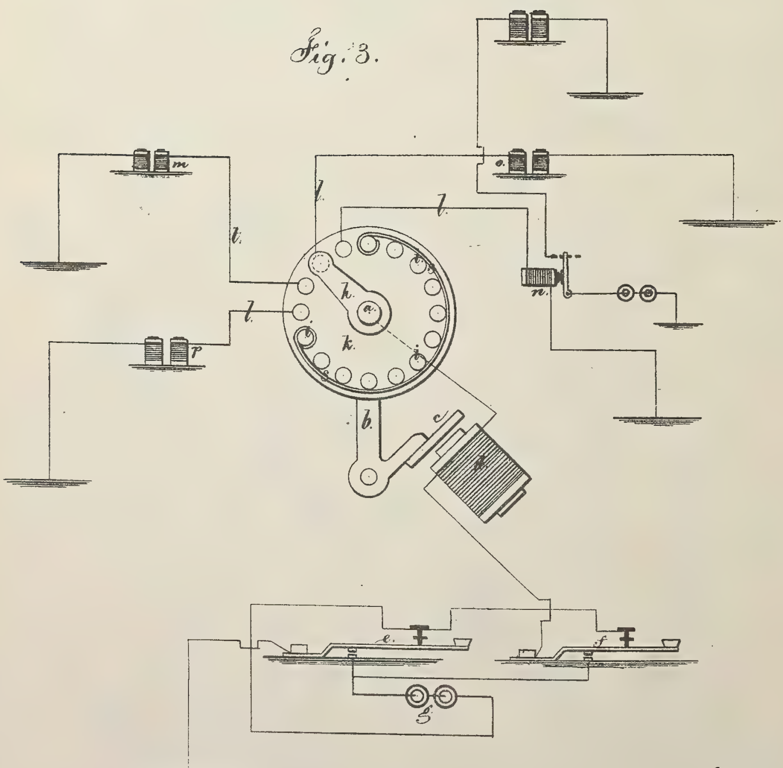
2 Sheets--Sheet 2.

T. A. EDISON.

Improvement in Rheotomes or Circuit-Directors.

No. 131,334. Patented Sep. 17, 1872.

Fig. 3.



Witnesses,

Chs. H. Smith

Geo. D. Walker.

Inventor

Thos. A. Edison,

L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN RHEOTOMES OR CIRCUIT-DIRECTORS.

Specification forming part of Letters Patent No. **131,334**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improved Rheotome or Circuit-Director; and the following is declared to be a correct description of the same.

This invention is for selecting from a number of telegraphic circuits the particular one to which a message is to be communicated. For instance, a connection from the sending-station, say at New York, may pass to this improved instrument located, say at Philadelphia, and by operating said instrument at Philadelphia by a negative current, a connection may be opened with a line to Reading, Harrisburg, Baltimore, or any other desired point, and communication be made direct or through a relay by pulsations of positive polarity, the rheotome instrument at Philadelphia remaining passive until again operated by a current of the opposite polarity.

I make use of a circuit-closing arm revolved in contact with the circular range of insulated circuit-closing pins by a step-by-step movement actuated by an electro-magnet upon an armature that is polarized, and the circuit is closed through one of said pins to the distant station, or to a relay-magnet to the distant station, and the step-by-step movement is actuated by pulsations of one polarity; but if the opposite polarity is employed there will not be any movement of the rheotome, because the polarity of the electro-magnet is such as to repel the polarized armature.

In the drawing, Figure 1 is a plan of the machine adapted to relay-magnets in local lines. Fig. 2 is an elevation of the said rheotome, and Fig. 3 is a diagram illustrative of the connections.

The vertical shaft *a* is revolved by a step-by-step movement of any desired character. I have shown the lever *b* and a ratchet-wheel. This lever *b* carries a polarized armature, *c*, that is operated by the electro-magnet or magnets *d* in the main-line circuits, and *e* and *f* are finger-keys, by means of which pulsations of positive or negative polarity can be sent over the main line from the battery *g* to the magnet or magnets *d*. The shaft *a* is also in the main-line circuit and carries the selecting-arm *h*, the end of which moves around in contact with the pins or conductors *i* in the rheotome-plate *k*. The conductors *i* are connected to the wires *l*, that lead to either distant magnets by line-wires or to relay-magnets *m n o p*, that are constructed in any desired manner to operate local or relay circuits, or perform any other desired operation. The end of the arm *h* must be wide enough to reach from one of the conductors *i* to the next while being moved around, otherwise the circuit will be broken, and the hand remain stationary, and I remark that the rheotome is adapted to a large number of circuits; but may be used with only three or four, and a wire, *s*, is employed to connect all the conductor-pins *i* that are not otherwise connected to local or relay circuits, so that the selector-hand may be revolved all the way round in making any selection desired.

The operator energizes the magnet *d* with pulsations that will cause the polarized armature *c* to be attracted, say, of positive polarity, and the current passes from the battery *g* through *f*, *d*, *a*, *h*, *i*, and *l* through one of the electro-magnets *m*, *n*, *o*, or *p*, and by the ground back through *e* to *g*, and according to the number of pulsations, so the arm *h* will stop over one or the other of the pins *i* and make the connection through the same to its magnet. When the key *e* is operated and pulsations of opposite polarity sent, the arm *h* will not be moved because the polarized armature *c* will remain unacted upon. The electric pulsations passing on through *h i l* may act in an electro-magnet to affect any object at *m p o*, Fig. 3. These electro-magnets are shown as at a distant station. They might, however, all be near the rheotome, as illustrated at *n*, to operate relay or local circuits. The wire *s* insures a circuit connection through either of the pins *i* that is not connected to a local or relay circuit.

Instead of using a single magnet, *d*, there might be a double one, and the armature vibrate between the cores; in this instance a retractile spring to the armature is rendered unnecessary, and the rheotome will be set by alternate pulsations of opposite polarity, and

the rheotome will not be moved by a repetition of pulsations of one polarity, and these will act at the distant magnet.

I claim as my invention—

1. The rheotome, formed of the arm *h* and conductor-pins *i*, in combination with the magnet *d* and polarized armature, substantially as and for the purposes set forth.

2. The wire or conductor *s*, connecting the circuit-pins *i i* of the rheotome, in combination with the arm *h*, magnet *d*, and polarized armature, substantially as set forth.

Signed by me this 6th day of May, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,335. Patented Sep. 17, 1872.

Fig. 2.

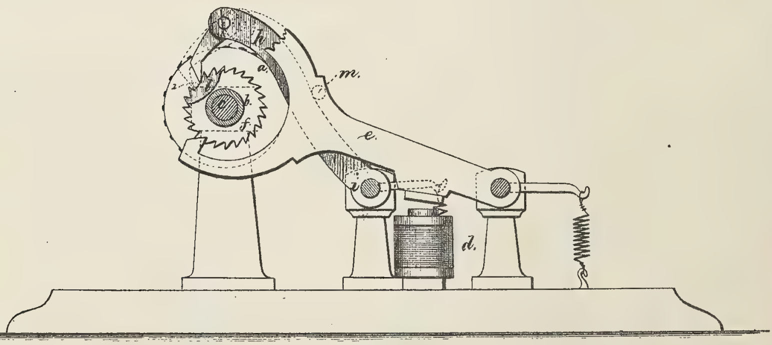
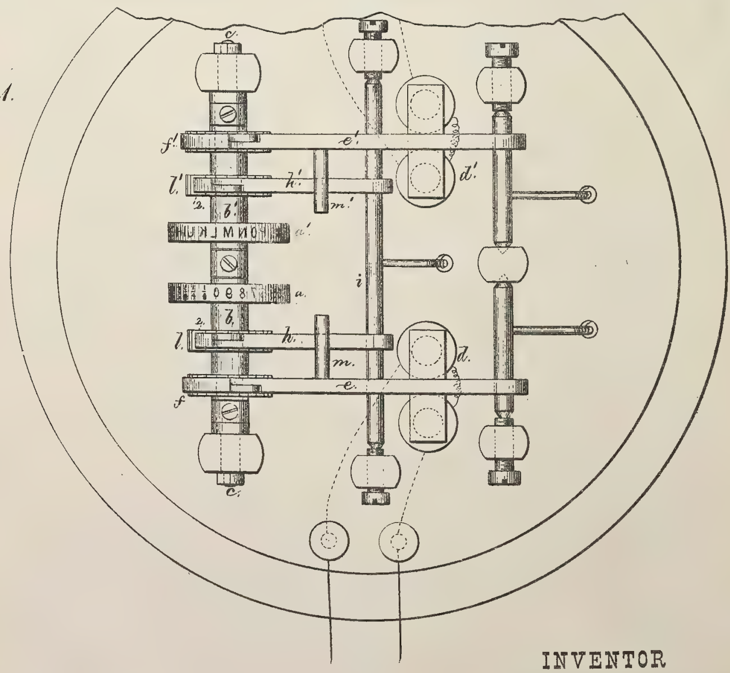


Fig. 1.



INVENTOR

Chas H Smith

Harold Serrell

Witnesses.

Thomas A. Edison,

Per Lemuel W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,335**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraph Instruments; and the following is hereby declared to be a full and correct description of the same.

This instrument is of that class in which two type-wheels, rotated by separate step-by-step movements, are employed to print in two lines upon one strip of paper. My improvement relates to employing an auxiliary lever and ratchet-wheel in connection with each of the usual type-wheel levers, and these auxiliary levers are so arranged that when either of the type-wheel levers is vibrated by its magnet to rotate the type-wheel the other type-wheel is rotated and brought to unison by means of the auxiliary lever acting upon its ratchet-wheel, and rotating said wheel until its pawl or pallet ceases to turn said wheel, in consequence of a tooth being removed from the same. The space where the tooth is removed from the ratchet-wheel is at a place in such relation to the zero or unison point of the type-wheel that when said ratchet-wheel stops revolving the type-wheel is at zero, and is in unison with the transmitter, and so remains ready to be brought into action by that instrument.

In the drawing, Figure 1 is a plan of my improved instrument, and Fig. 2 is a sectional elevation of the same.

a a' are the type-wheels secured to the sleeves *b b'*, which revolve upon the stationary shaft *c*, when actuated by their respective electro-magnets *d d'*, through the armatures and levers *e e'* and ratchet-wheels *f f'*. The magnets *d d'* are in independent electric circuits, and either type-wheel may be revolved, stopped, and printed from, according to which magnet is energized, as heretofore usual. *h h'* are the auxiliary levers upon the shaft or fulcrum *i*, and *l l'* are their respective ratchet-wheels secured to the sleeves *b b'*; and from each wheel *l l'* a tooth is removed, as at 2. These levers *h h'* are contiguous to the levers *e e'*, and pins *m m'* project from the same and rest upon said levers *h h'*. When either type-wheel is in use—say the wheel *a'*—its lever *e'* is vibrated by the magnet *d'*, and its pin *m'* will vibrate the auxiliary lever *h'*, and, through the shaft *i*, will vibrate the lever *h'* and rotate the ratchet-wheel *l* and its sleeve and type-wheel *a*; and said wheel *l* will be rotated until the pawl or pallet of *h* arrives at the space 2, where the tooth is removed; and said pawl will then move up and down in said space without turning the wheel *l*, if the lever *h* continues to be vibrated. The type-wheel *a* is now at zero and in unison with the transmitter, ready to be brought into action by that instrument. The wheel *a*, when in use, acts, by its lever *e* and pin *m*, to vibrate the lever *h'*, to rotate the ratchet-wheel *l'* and bring the type-wheel *a'* to unison.

The printing-lever and its magnet are not shown in the drawing. They may be of any desired character, and the magnet may be in a separate electric circuit or in a circuit to the magnets *d* or *d'*. Ordinarily the change in operating the type-wheels will take place at the zero-points; hence the levers *h h'* will not be operative unless there has been a loss in the movement of the type-wheel that is thrown out of action.

I claim as my invention—

Two type-wheels separately revolved by a step-by-step motion, in combination with a separate lever or levers operated by the mechanism that is moving one type-wheel to set the other type-wheel, substantially as specified.

Signed by me this 15th day of June, A. D. 1872.

T. A. EDISON.

Witnesses:

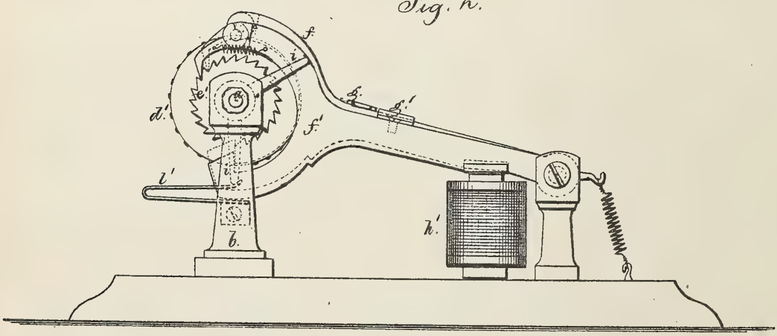
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,336. Patented Sep. 17, 1872.

Fig. 2.



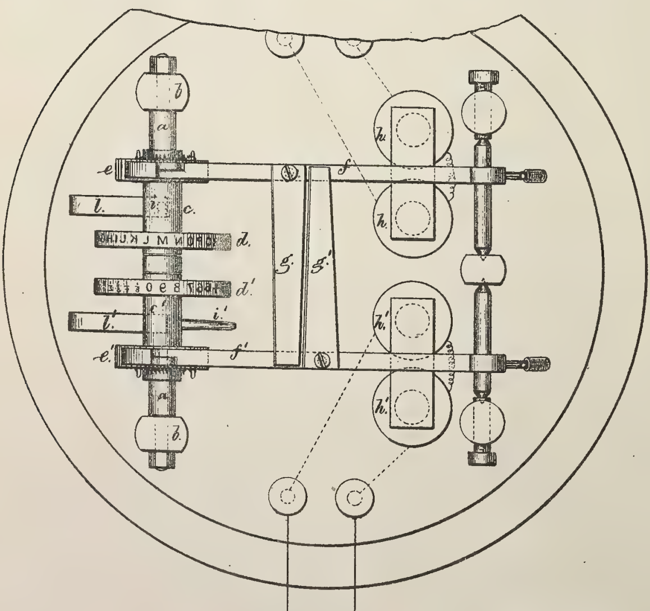


Fig. 1.

INVENTOR

Thomas A. Edison

Per: Lemuel W. Serrell ATTY.

Chas H Smith

Harold Serrell

Witnesses.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,336**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraph Instruments; and the following is hereby declared to be a full and correct description of the same.

In this instrument there are two type-wheels—one a letter-wheel, the other a figure-wheel—both revolving upon a shaft, and each sleeve or shaft and its wheel is actuated by a separate step-by-step movement.

My invention relates to two type-wheel levers connected to each other by yielding or spring arms, so that when one type-wheel lever is vibrated by its magnet and armature to rotate its type-wheel, its spring-arm will act to vibrate the other type-wheel lever and rotate its type-wheel until said wheel is brought to the zero-point and arrested by a yielding unison stop, when the spring-arm will yield, not being of sufficient strength to move said lever against the resistance offered by the unison stop. By this arrangement of parts, if the type-wheel that has been in use is not in unison, the other type-wheel moves it forward until it reaches the zero-point, and is, in unison with the transmitter, ready to be brought into action by that instrument.

In the drawing, Figure 1 is a plan of my improved instrument, and Fig. 2 is an elevation of the same.

a is a stationary shaft sustained in the standards *b b*, and upon this shaft are sleeves *c c'*, to which are secured the type-wheels *d d'* and ratchet-wheels *e e'*, respectively; or two short shafts may be employed with a central support. The type-wheel *d* is rotated in its step-by-step movement by the electro-magnet *h*, armature and lever *f*, and wheel *e*, and the type-wheel *d'* is rotated by the magnet *h'*, armature and lever *f'*, and wheel *e*, and these magnets *h h'* are in separate electric circuits, or otherwise rendered operative upon their respective armatures. *g* is a spring-arm secured to the lever *f*, and at its outer end resting upon the lever *f'*. *g'* is a second arm secured to the lever *f'*, and resting at its outer end upon the lever *f*. *i i* are the unison arms upon their respective sleeves *c c'*, and *l l'* are yielding stops for said arms to take against in their movement.

If the type-wheel *d'* is in use, and its lever *f'* vibrated by its magnet *h'*, the lever *f* will also be vibrated by the spring *g'* pressing upon the same, and it will continue to actuate said lever and rotate the type-wheel *d* until the arm *i* takes against the stop *l*, as shown in Fig. 2, and stops said wheel at zero. The spring *g'* now ceases to move the lever *f*, but yields each time the lever *f'* is drawn down by its magnet, said arm not having sufficient strength to move the lever *f* and turn the ratchet *e* one tooth to carry the arm *i* past the yielding stop *l*. The arm *g* acts in a similar manner when the lever *f* is vibrated and the type-wheel *d* is in use, and brings the type-wheel *d'* to zero.

It is to be understood that the wheel being printed from is not stopped by the arm *i* or *i'* taking against the stop *l* or *l'*, because the magnet is sufficiently powerful to overcome the resistance of the spring-stop and carry the arm *i* or *i'* past said stop.

The printing may be effected in any desired manner, such as by a printing lever and pad actuated by an electro-magnet in a circuit separate from the magnets *h* or *h'*, or in any of the known modes.

One spring attached at both ends might be employed, instead of the two springs *g g'*.

I claim as my invention—

Two type-wheels actuated by separate step-by-step movements, in combination with a spring arm or arms extending from one lever to the other, and a yielding unison stop for each type-wheel, substantially as set forth.

Signed by me this 15th day of June, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

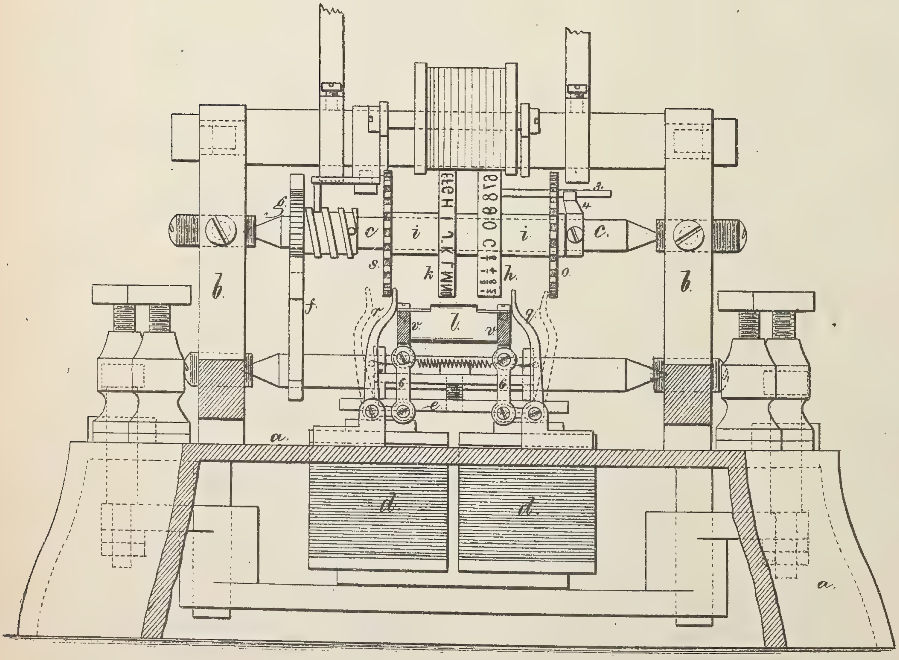
2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,337. Patented Sep. 17, 1872.

Fig. 1.



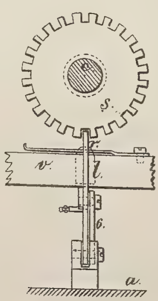


Fig. 2.

Witnesses

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison

Lemuel W. Serrell

atty

2 Sheets--Sheet 2.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,337. Patented Sep. 17, 1872.

Fig. 4.

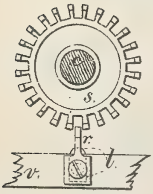
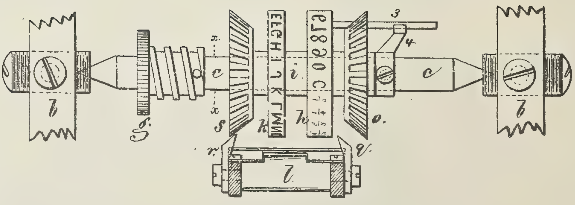


Fig. 3.



Chas. H. Smith.
Harold Serrell
Witnesses.

INVENTOR
Thomas A. Edison
Per. Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,337**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description thereof.

This invention is for shifting the type-wheels lengthwise of the shaft so as to bring one into action and move the other out of action. This has been accomplished by me at certain points in the revolution of the type-wheel by pins upon the printing-lever acting upon a T-lever. I now dispense with the T-lever and provide for means for shifting the type-wheels at any letter. The escapement I employ receives motion from a magnet, and the type-wheels are rotated half of the space between one letter and the next when the circuit is closed, and the other half by the movement of the lever when the circuit is open; and the two type-wheels are so applied that the characters on one are in line for printing with the closed circuit and the other in line for printing with the open circuit. Notched wheels are applied at the sides of the type-wheels, and projections are moved by the printing-lever, so that if the type-wheel to be printed from is not in position the parts will be moved in the act of operating the printing-lever. It is to be understood that this printing instrument is operated by two line-wires on separate circuits, one through the printing-magnet and the other through the type-wheel magnet, and that a number of instruments can be used in the same circuits.

In the drawing, Figure 1 is an elevation, with the bed in section, of my instrument. Fig. 2 is a view of the notched wheel and lever endwise of the shaft. Fig. 3 shows the type-wheels, shaft, and notched wheels in a modified form; and Fig. 4 is a view endwise of the shaft, showing the notched wheel and actuating tooth.

The bed *a*, frame *b*, type-wheel shaft *c*, and type-wheel magnet *d* are of usual character. The armature *e* moves the step-by-step escapement or wedge-acting pallets of the lever *f* so as to move the wheel *g* and shaft *c* progressively half a letter space as the magnet *d* is energized, and the other half space when the magnet is discharged. The type-wheels *h k* are placed upon the sleeve *i*, that can slide endwise upon the shaft *c*, and is guided by the rod 3 and arm 4, and the position of these type-wheels is such that a plane passing through the center of a letter on the wheel *h* will pass midway between two letters or characters on the wheel *k*; hence the characters on *h* will be in line with the impression-pad *l* for printing when the circuit through *d* is kept closed, and the characters on the wheel *k* will be in line for printing with the circuit open. In order to print from only one of the type-wheels it is necessary that either the type-wheels should be moved endwise or that the printing-pad should be moved from beneath one wheel to the other. I accomplish this by means of wheels *o* and *s*, that are notched around their edges with as many notches as there are type or letter spaces in the wheels; and these are placed in such position to the type-wheels that they control the impression. In Figs. 1 and 2 there are levers *q* and *r*, that are moved by the links 6 that connect with the printing-lever *v*; hence, each time the printing-lever is actuated the upper ends of these levers *q* and *r* swing outwardly. If the type-wheel requires to be shifted to print on an open circuit (when it had been printing on a closed circuit) the end of the lever *r* will come in contact with the projection of the wheel *s* and slide the type-wheels endwise and bring the type-wheel *h* into line for printing, and at the same time the end of the lever *q* will pass through one of the notches in *o*. The reverse movement will take place when the printing-lever is actuated while the type-wheel is held by its magnet on a closed circuit, so that the operator can select either type-wheel and impress a character from either the one or the other. The same end movement is given to the type-wheels by the mechanism shown in Figs. 3 and 4, in which the faces of the wheels *o s* are conical and are acted upon by the inclines *q* or *r* that take the place of the levers in Figs. 1 and 2; and it will be evident that if the printing-pad was mounted so as to be shifted endwise in a transverse slide upon the printing-lever it might be done by either of the movements aforesaid, and in that case the type-wheels and wheels *o* and *s* would remain stationary upon the shaft *c* and the printing-pad slide beneath them. A shield of thin sheet metal, with an opening through which the

impression is made, may also be employed, and either slide with the printing-pad or this shield alone may be moved transversely by the aforesaid mechanism to allow of the printing being from only one of the type-wheels at a time.

I claim as my invention—

1. The notched wheels *o s*, in combination with the type-wheels *h k*, and mechanism, substantially as set forth, for moving the type-wheels or the printing-pad, or shield to select the type-wheel from which the impression is to be made, substantially as set forth.

2. Two type-wheels, with the characters of one in line with the spaces between the characters on the other, and a step-by-step movement that is operative when the electric circuit is both closed and opened, in combination with the notched wheels *o* and *s*, and mechanism for selecting the type-wheel to be printed from, substantially as set forth.

3. The conical-faced notched wheels *o s*, in combination with the inclined stops *q r* and type-wheels *h* and *k*, substantially as set forth.

4. The swinging levers *q* and *r*, actuated by the printing-lever *v*, in combination with the type-wheels *h* and *k* and notched wheels *o s*, substantially as set forth.

5. The combination of two type-weels and a printing-lever, with mechanism moved by the printing-lever, substantially as set forth, for printing from one type-wheel when the type-wheel circuit is open and from the other when that circuit is closed, substantially as set forth.

6. A shifting movement derived from the printing-lever, operating in one direction with a closed circuit and in the other direction with an open circuit, substantially as set forth.

Signed by me this 10th day of June, 1872.

T. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,338. Patented Sep. 17, 1872.

Fig. 3

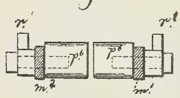


Fig. 2

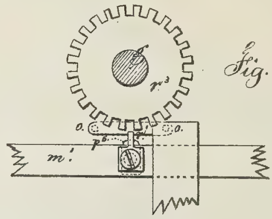
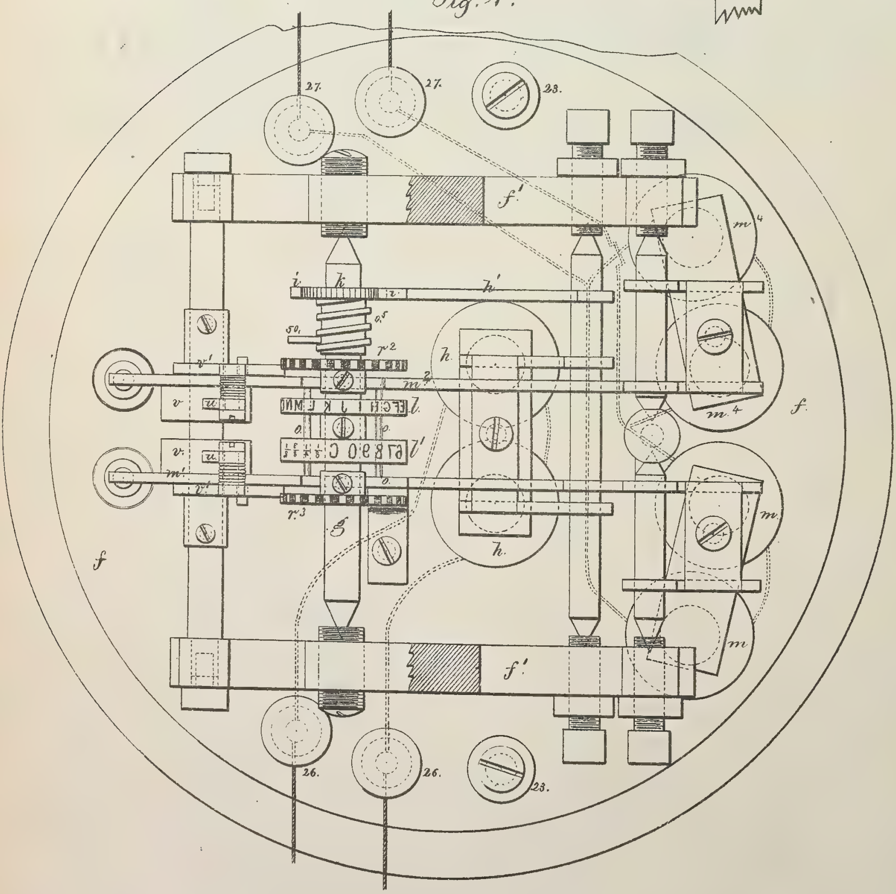


Fig. 1.



INVENTOR

Chas. T. Smith

Thomas A. Edison

Witnesses.

Harold Serrell

Pr. Lemuel W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,338**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same:

The printing-lever is made in two parts, with a pad to each; the electric pulsation passes through the two magnets that operate these printing-levers, but there is not any impression from one of the two type-wheels, because the movement of its lever is arrested by a projection on the printing-lever coming against one of the teeth of a wheel that is moved with the type-wheels; the other type-wheel is printed from because the space between the teeth is in line with the projection on the printing-lever, and hence does not check its movement.

In the drawing, Figure 1 is a plan of my improved instrument; and Figs. 2 and 3 are detached views of the same.

The shaft g of the type-wheels l l' is sustained by the frames f' on the bed f, as usual. The type-wheel magnet h is energized by pulsation through the line-wires connected at 26. The lever h' and pallets i act to rotate the toothed wheel k and shaft g, as in other printing-telegraphs, and the screw-unison o^5 and stop 50 are similar to those in patents heretofore granted to me. The magnets m m^4 are in the electric circuit from the wires 27, either by passing through all the helices or by dividing the current so that half passes through each magnet. The drawing shows by dotted lines the connections arranged so that the current is divided between m and m^4, and both magnets will be energized when an electric circuit is completed through 27. The type-wheels l l' are placed, as shown, with the spaces in one opposite the types in the other, hence the types in l will be in line for impressing, with a closed circuit, and those in l' in line for impressing with an open circuit. The notched or toothed wheels r^2 r^3 are positioned similarly to the type-wheels l l', and upon the levers m^1 m^2 are projections r r^1; hence, with a closed circuit through h the wheels r^2 r^3 will be in such a position that the projection r will pass into the notch in r^2, and the lever m^2 and its pad p^6 be moved freely and give the impression; but an impression will not be given by the lever m^1 because its projection r^1 is stopped by one of the teeth on r^3. If the circuit through 27 is closed when the circuit through h is broken, the wheel l' will be printed from, as its projection r^1 will pass into one of the notches in r^3, as seen in Fig. 3, and the impression will not be made from l, because the stop r of m^2 comes in contact with one of the teeth of r^2. The guide-wires and frame o are held by a bracket to the bed f and keep the strip of paper in position relatively to the type-wheels. The feeding-pawls n act against the turning segments v, and they are actuated by the levers v^1 and the respective printing-levers m^1 m^2 when either one is moved, and one pawl, n, holds the paper as the other draws back.

I claim as my invention—

1. The wheels r^3 r^4, projections r r^1, and levers m^1 m^2, in combination with the type-wheels l l', substantially as set forth.

2. Two separate printing-levers and their respective magnets in the same or branch circuits, in combination with two type-wheels, positioned as specified, and mechanism substantially as set forth, for preventing an impression from one of the type-wheels while the other is being printed from, substantially as set forth.

Signed by me this 29th day of June, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,339. Patented Sep. 17, 1872.

Fig. 2.

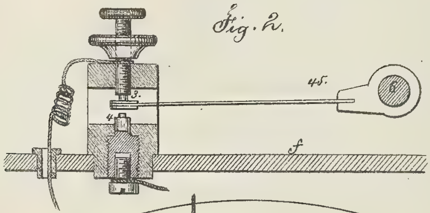
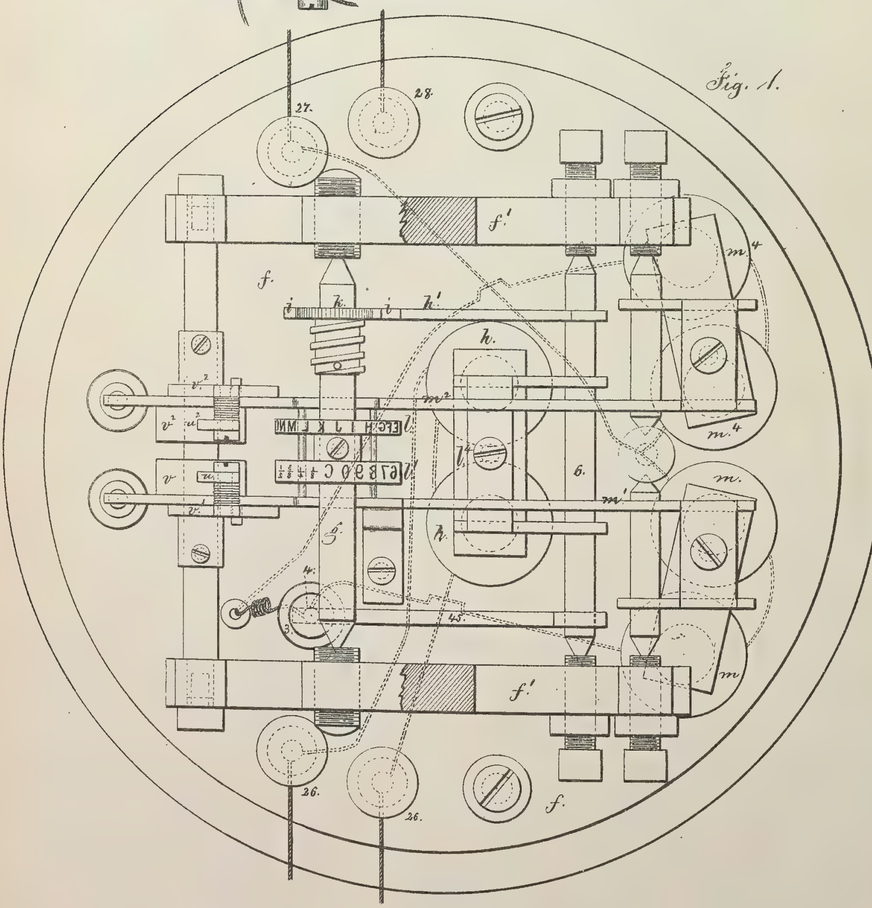


Fig. 1.



Chas H Smith

Harold Serrell Witnesses.

INVENTOR

Thos. A. Edison,

Per. Lemuel W. Serrell

ATTY.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,339** dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

In this telegraph there are two type-wheels, two printing-levers, and contiguous printing-pads, and there is a separate magnet to each printing-lever. The step-by-step movement revolves the type-wheel, and there is a half-space moved by the pallets when the circuit to the printing-magnet is closed, and the other half space is moved at the reverse movement of the armature away from the magnet. The type-wheels are positioned so that the letters in one are in line with the spaces between the letters in the other. An arm is provided that vibrates with the armature of the type-wheel magnet, and acts as a circuit-closer, so that when the type-wheels are stopped with the armature drawn toward the type-wheel magnet this circuit-closing arm will complete the circuit to the magnet that acts upon the proper printing-lever. The circuit to the other printing-lever is closed by the rising of the armature from the type-wheel magnet. This instrument is adapted to printing letters from one type-wheel, and numbers and fractions from the other wheel, and either can be brought into action at any time, the letters being in position with a closed circuit, and the numbers in position with the open circuit through the type-wheel magnet, or the reverse. Two line-wires, of course, are required to operate a number of instruments; one goes through the type-wheel magnets and the other through the printing-magnets. The general characteristics of this machine are the same as those heretofore described by me in other applications for patents, except in the particulars hereafter described.

In the drawing, Figure 1 is a plan, and Fig. 2 is a detached sectional view of my improved instrument.

The type-wheel magnet h is in the electric circuit to the line-wires 26. Its armature l^4 acts upon the levers h' and pallets i to move the toothed wheel k, shaft g, and type-wheels l l^1 half a space on the type-wheels as the circuit is closed through h, and the other half as the circuit is broken and the armature retracted by a spring. The spring-arm 45 is upon the shaft 6, and moved at the same time as the armature l, and plays between the circuit-closers 3 and 4. When the circuit through h is closed one character on the type-wheel l' will be in line for printing, and the spring 45 will close the circuit from 27 through the magnet m, closer 4, spring 45, shaft 6, frame f', bed f, and binding-screw 28 to the line; hence, the lever m^1 will be operated to impress from the type-wheel l^1, and by the clamp and pawl u v and lever v^1 to feed the paper as soon as a pulsation is sent through 27. If the type-wheels are stopped with circuit through h broken, the circuit-closer 45 will be in contact with 3; hence, a pulsation through 27 will pass by the magnet m 4, closer 3, spring 45, shaft 6, frame and bed f' f to 28, and operate the printing-lever m^2 and give an impression from the type-wheel l, and by the clamps and pawls v^2 u^2 and lever v^2 feed the paper. By this arrangement either type-wheel can be printed from at pleasure, and there are not any parts to shift or change.

I claim as my invention—

The circuit-closing arm 45 and connections 3 4 to the respective magnets m m^4, in combination with the printing-levers m^1 m^2, type-wheels l l^1, and actuating mechanism, substantially as set forth.

Signed by me this 29th day of June, A. D. 1872.

T. A. EDISON.

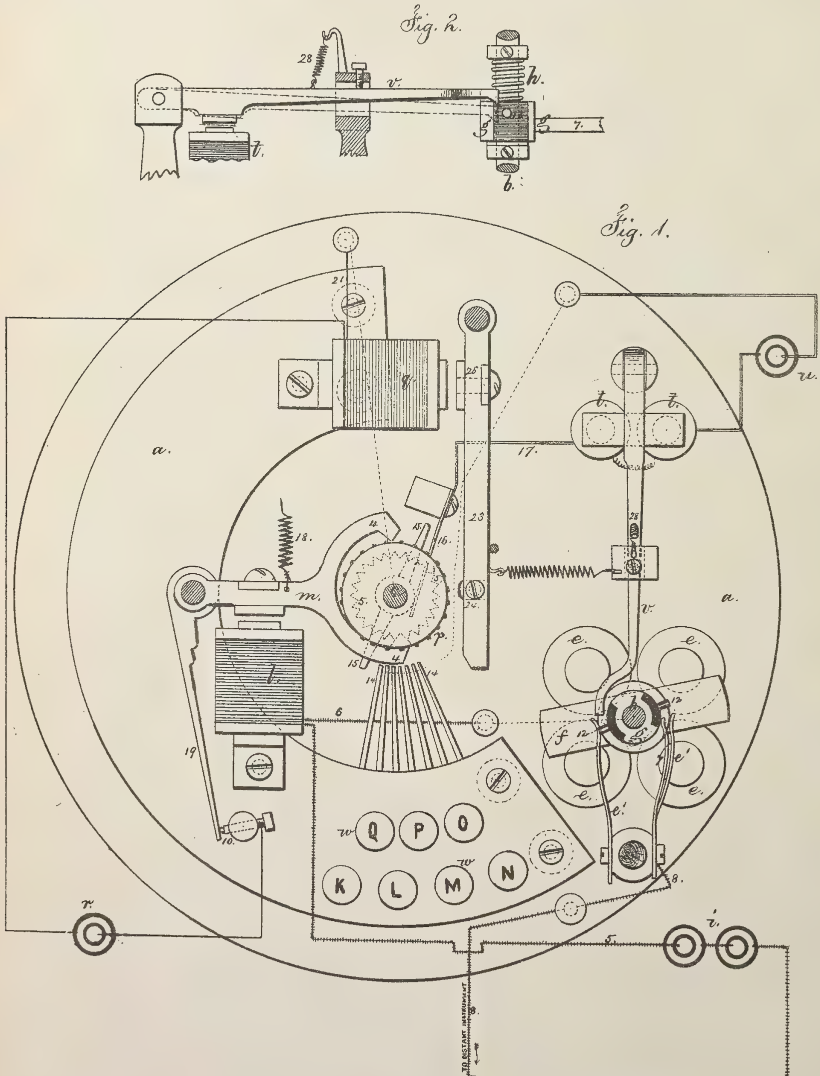
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,340. Patented Sep. 17, 1872.



INVENTOR

Thomas A. Edison,

Per. Lemuel W. Serrell

ATTY.

Chas. H. Smith

Harold Serrell Witnesses.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,340**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the State of New Jersey, have invented an Improvement in Printing-Telegraph Instruments; and the following is hereby declared to be a full and correct description of the same.

In this instrument an electro-motor gives rotation to a vertical shaft, and upon this shaft is a pulsator which makes and breaks the circuit to the type-wheel magnet, and, by the pulsations transmitted, revolves the type-wheel and its shaft by a step-by-step motion.

The present improvement relates to means for arresting the rotation of the pulsator, when a finger-key is depressed, so as to break the circuit to the type-wheel magnet of the distant instrument or instruments in the circuit, and stop the type-wheels so that the desired letter may be printed by an electro-magnet that is brought into action by the act of arresting the movement of the type-wheel.

Upon the type-wheel shaft is an insulated arm, and when a key is depressed one end thereof is brought into the path of this arm, and stops the movement of the shaft and closes a circuit through a magnet which draws down an armature and lever, and brings the outer end of the lever in the path of a pin upon the pulsator, stopping the same upon the open circuit of the type-wheel magnet, and hence arresting the movement of all the type-wheels in that circuit; at the same time a local circuit to the printing-magnet is closed and the printing is effected.

In the drawing, Figure 1 is a sectional plan of said instrument, and Fig. 2 is a detached view of the pulsator and its stop-lever and magnet.

a represents the bed of the machine, and in suitable steps or bearings are mounted the pulsator and type-wheel shafts *b* and *c*, respectively. The shaft *b* is revolved continuously by suitable power, such as the electro-motor, composed of the helices *e e*, armature *f*, and connections (not shown in the drawing) from the springs *e'* to a battery, and upon this shaft is the pulsator *g*, composed of alternate conductors and non-conductors, and said pulsator revolves with said shaft *b* by frictional contact derived from the spring *h*. This pulsator *g* makes and breaks the circuit to the battery *i* through the type-wheel magnet *l*, moving its armature and lever *m*, and communicating, by the pallets 4 4 and ratchet-wheel 5, the necessary step-by-step movement to the shaft *c* and its type-wheel *p*. This circuit from the battery *l* is from the battery *i*, by wire 5, to said magnet *l*, thence, by wire 6, to the bed of the machine, and by shaft *b*, pulsator *g*, spring-arm 7, and wire 8, to distant instrument, and by return wire or earth, back to battery.

When it is desired to stop the type-wheel at a particular letter and impress the same, the pulsator *g* must be arrested in its movement, and with the spring-arm 7 upon a non-conducting part of *g*, so as to break the circuit to the type-wheel magnets *l* and close a local circuit at 10 to the printing-magnet *q* from the battery *r*.

I arrest the movement of the pulsator as follows: *t t* is an electro-magnet in a circuit to the battery *u*, and when said magnet is charged its armature is attracted and the lever *v* drawn down to the position shown by dotted lines in Fig. 2, bringing its outer end into the path of one of the pins 12 12, which project from the non-conducting portions of the pulsator *g*, thereby stopping its movement.

When one of the range of finger-keys is depressed its outer end 14 is moved into the path of the insulated arm 15 on the type-wheel shaft *c*. This stops the revolution of that shaft *c* with the designated letter in position for printing, and at the same time closes a circuit through the hub of 15 and insulated spring 16, wire 17, magnet *t*, to the battery *u;* thence, by the bed *a* and finger-key arm 14, to the arm 15. The magnet *t* attracts its armature and brings the outer end of the lever *v* into the path of the pin 12, so as to take against one of said pins, as aforesaid, and stop the revolution of the pulsator.

The pins 12 are so located that when the pulsator is stopped the spring arm 7 is upon an insulated part of *g;* hence the circuit to the magnet *l* is broken and the armature and lever *m* are drawn away from the magnet *l* by the spring 18. This brings the arm 19 in contact with the screw 10, closing the circuit to the battery *r*, and the current from the same passes by 10, 19, *m*, *c*, *a*, and wire 21 to the magnet *q*

to charge the same and attract the armature 26, and effect the impression by the lever 23 and pad 24.

When the finger is removed from the depressed key *w* said key rises and the circuit is broken at 14 15 to the magnet *t*, and the lever *v* is drawn up by its spring 28, liberating the pin 12, and the pulsator again revolves with the shaft *b*, and makes and breaks the circuit to the magnet *l*, as aforesaid.

It is to be understood that the contact of 19 and 10 is so momentary that when the type-wheel shaft *c* is being revolved the magnet *q* does not become sufficiently charged to effect the printing.

It is also to be understood that the finger-keys are to be extended to form a semicircular range, or otherwise positioned to include all the characters, and that the other parts may be arranged in relation to each other in the most convenient positions. The paper-feed may be of any desired character.

I claim as my invention—

1. The pulsator, acting to make and break the circuit to the printing-magnet *l*, in combination with the arm 15, electro-magnet *t*, and connections for arresting the pulsator simultaneously with the stopping of the type-wheel, substantially as set forth.

2. An electric circuit closed by the contact of the revolving arm 15 with the finger-key stop 14, in combination with the type-wheel and actuating mechanism, substantially as set forth.

3. The arm 19, moved by the escapement-lever *m*, and acting to close the circuit to the printing-magnet *q*, in combination with the pulsator *g*, magnet *t*, and circuits, substantially as set forth.

Signed by me this 10th day of June, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing Telegraph Instruments.

No. 131,341. Patented Sep. 17, 1872.

Fig. 1.

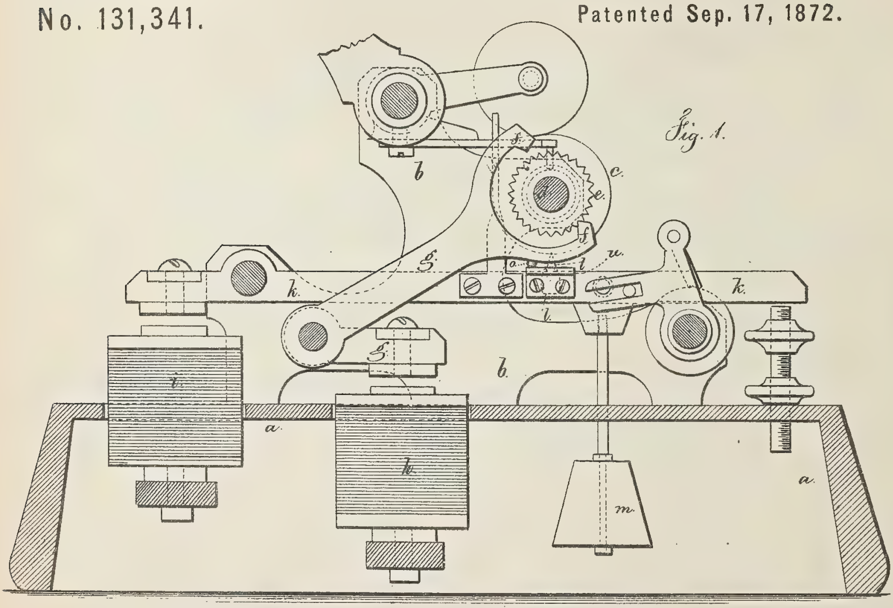


Fig. 2.

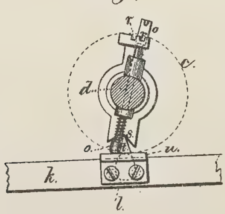
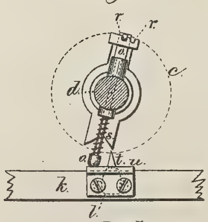


Fig. 3.



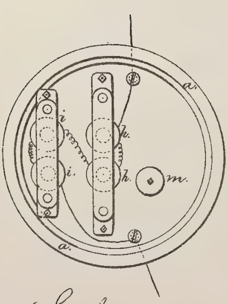


Fig. 5.

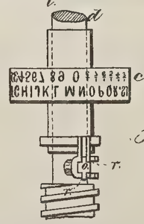


Fig. 4.

Chas H. Smith

Geo. D. Walker

Witnesses.

INVENTOR

Thos. A. Edison,

Per L. W. Serrell

ATTY.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. **131,341**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, and the following is declared to be a correct description of the same.

Before my present invention the printing-lever magnet had been placed in the same circuit as the type-wheel magnet, and the former had been prevented from giving an impression each pulsation by a spring acting upon the printing-lever; but unless the pulsations that set the type-wheel lever were very rapid, the printing-lever would be moved more or less. If the spring is under considerable tension, so as to prevent an impression until a pause occurs after the type-wheel has been set, the printing-magnet accumulates sufficient force to overcome said spring; but the impression is not reliable, because the spring prevents the pad giving a blow, and the said spring accumulates resisting power to the action of the magnet as the printing-lever is moved.

My present invention is made for effecting the printing by a blow resulting from the motion of a weighted lever. The weighted lever resists the action of the printing-magnet, so as not to move until the force of the electro-magnet is sufficient, and then the inertia of the moving weight insures a sufficiently-powerful blow to print from the type-wheel. In this manner a series of printing-telegraph instruments can be worked successfully in a one-wire circuit, and all polarized switches and electrical circuit-changers are dispensed with. I also make use of a mechanism for turning the type-wheel partially around upon its shaft, to bring one range of letters or figures into position and take out of action the intermediate figures.

In the drawing, Figure 1 is a longitudinal section of the said machine, and Figs. 2, 3, and 4 are detached views of the type-wheel shifting mechanism.

The base *a*, frame *b*, type-wheel *c*, shaft *d*, ratchet-wheel *e*, and pallets *f*, moved by the lever *g*, are of usual construction, and the type-wheel magnet *h* and printing-magnet *i*, are of ordinary character, and may be either in one electric circuit, or in separate circuits, although especially designed for use in one electric circuit, as represented in Fig. 5. The printing-lever *k* and pad *l* are also of ordinary construction, with the exception that the weight *m* is attached to said lever *k*, in order that it may prevent the printing-lever acting when the magnet *i* is only slightly energized; but when said magnet is sufficiently powerful to move the weight and lever, said weight gives the necessary blow to effect the printing much more perfectly than can be done with the same electric current and a spring to restore the printing-lever to a normal position. The type-wheel *c* is to be made with the desired letters or characters in two ranges—for instance, numbers may be placed between the letters to alternate with them, or the numbers may be upon a separate type-wheel, the characters of one coming opposite the spaces of the other, and the step-by-step motion is sufficient to move the type-wheel from one letter or character to the next in either range; hence one of the ranges will be out of action and the other in position; and to change so as to print from the range that had been out of action requires that the type-wheel or wheels shall be rotated upon the shaft a distance equal to half the movement given by one of the step-by-step motions. I effect this by the movement next described. Across the shaft *c* is the spring-locking bolt *o*, having a T-head, and upon the sleeve carrying the type-wheel or wheels is an arm having notches, *r*, at one end for the T-head of the bolt *o* and at the other end a fork, *s*, for the stud *t* upon the impression-lever *k*. A plate, *u*, upon the impression-lever acting upon the bolt *o*, raises its T-head out of one of the notches *r*, and at this time the type-wheel can be partially rotated. If the position of the parts is such that the stud *t* acts against the fork *s*, the type-wheel will be moved either one way or the other, according to which side of the fork said inclined stud *t* takes against as the printing-lever rises, the bolt *o* being disconnected, and upon the printing-lever falling, the T-head of the bolt secures the parts in position by entering one of the notches *r*.

It is to be understood that the operator at the transmitting-station can shift all the type-wheels at once in the various machines in the electric circuit by bringing them around to the point where the stud of the printing-lever

will operate upon the proper inclined side of the fork *s*, and then actuating the printing-lever to disconnect the bolt *o* and then turn the type-wheel or wheels *c* to bring one range of types into action and turn the other range around, so that the impression-pad will not act against either of the types therein; but it will be below the space between the types in one range of type, and impress from the types of the other range of types.

I claim as my invention—

1. The printing-lever and weight, in combination with the type-wheel and an electro-magnet, for the purposes and as set forth.

2. The bolt *o*, notches *r*, and fork *s*, in combination with a type-wheel or wheels having two ranges of figures or letters and the printing-lever and stud *t*, as and for the purposes set forth.

3. The combination, in one electric-circuit, of two or more type-wheel magnets, and two or more printing-magnets, and two or more weighted printing-levers, substantially as set forth, whereby the printing will be effected by the same pulsation used to bring the type-wheel to place, but only when the printing-magnet has accumulated sufficient force to give a blow by the weighted printing-levers, substantially as set forth.

Signed by me this 28th day of May, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

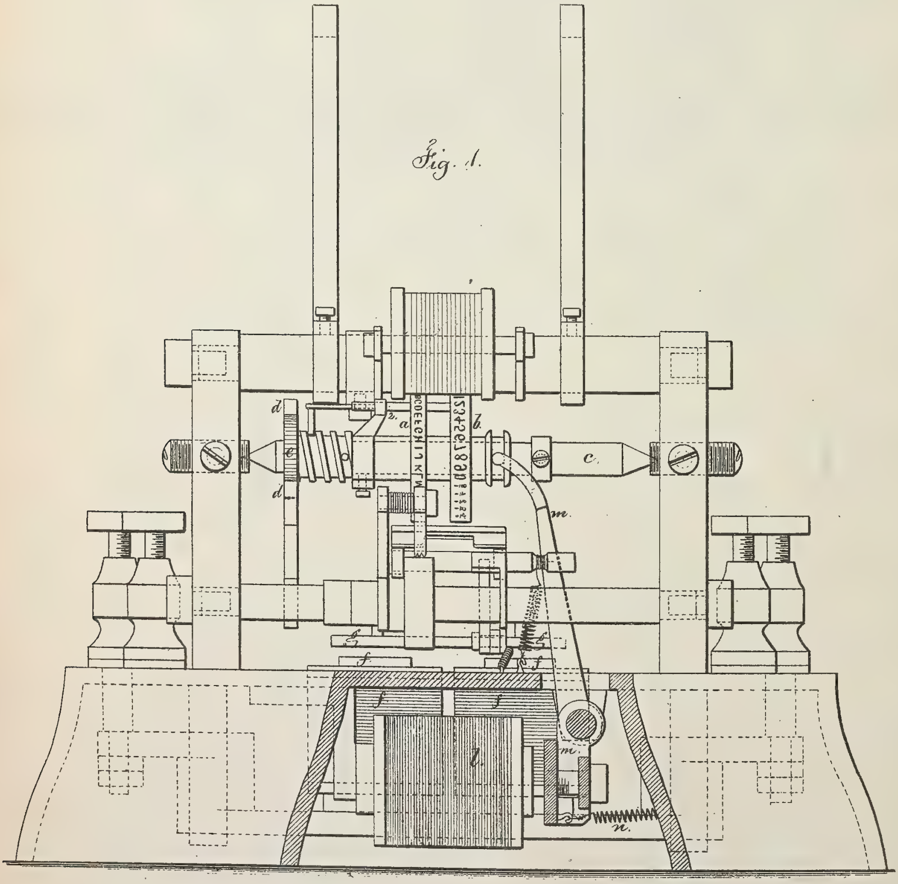
2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Printing Telegraph Instruments.

No. 131,342. Patented Sep. 17, 1872.

Fig. 1.



Witnesses.

Chas H Smith

Geo. D. Walker.

INVENTOR

Thos A. Edison,

Per. Lemuel W. Serrell

ATTY.

AM. PHOTO-LITHOGRAPHIC CO N.Y. (OSBORNE'S PROCESS)

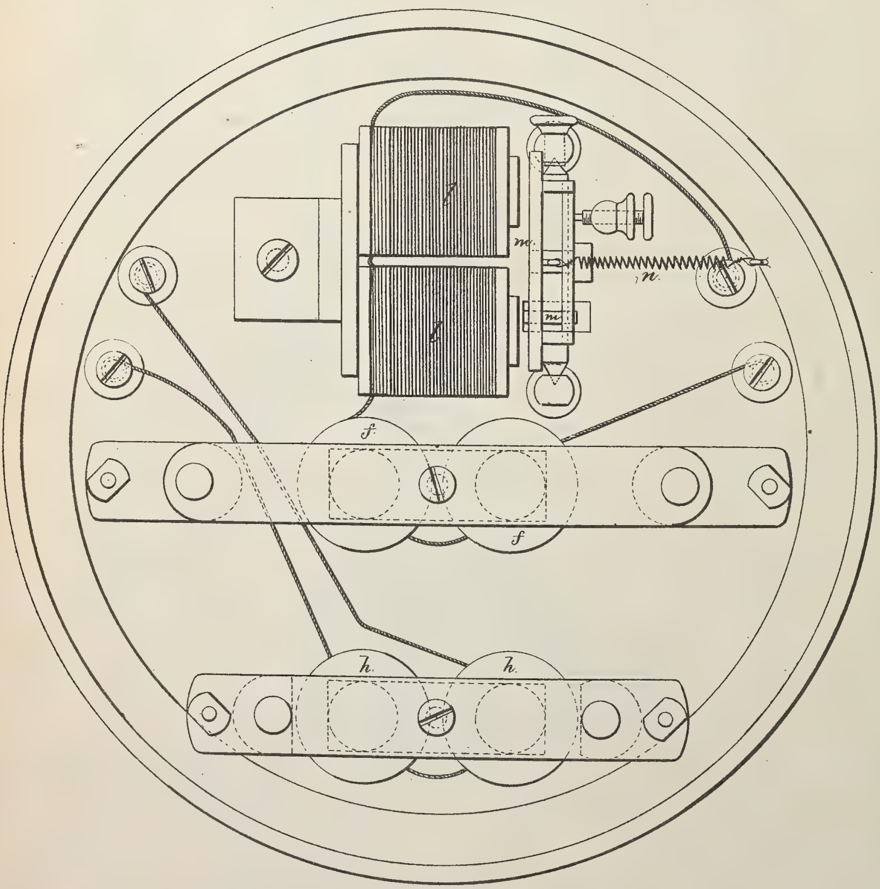
2 Sheets--Sheet 2.

T. A. EDISON.

Improvement in Printing Telegraph Instruments.

No. 131,342. Patented Sep. 17, 1872.

Fig. 2.



INVENTOR

Thos. A. Edison,

Per. L. W. Serrell

ATTY.

Chas. H. Smith

Geo. D. Walker

Witnesses.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. **131,342**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

The present invention applies to improvements applicable with other printing-telegraphs heretofore made and patented by me.

I make use of two type-wheels sliding endwise of the actuating-shaft, the one having figures or fractions, or both, and the other letters, and these are positioned so that when the circuit to the type-wheel magnet is closed and held during the energizing of the printing-magnet by a separate electric circuit, the letter-wheel will be drawn by a magnet into position for printing, and when the circuit is broken the figure-wheel will assume its position over the paper to be impressed. The magnet that gives endwise movement to the type-wheels, not being energized, allows a spring to give the reverse movement. By this means the letter and type wheels are moved around to the required point; and if a letter is to be impressed, the circuit is kept closed; or if a figure, the circuit is broken before impression, or the reverse. In this manner circuit-changers and polarized bars can be dispensed with and the end movement of the type-wheel is independent of any unison or changing points, as either wheel can be brought into or removed from action at any point of the revolution.

In the drawing, Fig. 1 is an elevation; and Fig. 2 is an inverted plan of the instrument.

The type-wheels *a b* are connected by a sleeve and slide freely endwise of the shaft *c*, and are guided by the rod 2, that also serves to communicate to the wheels the rotary motion of the shaft. The step-by-step movement of the type-wheels is given by the pallets *d*, acting upon the ratchet-wheel *e*, and *f* is the type-wheel magnet, the armature *g* of which moves the lever and pallets *d*. The printing-magnet *h* is in a separate circuit from the type-wheel-magnet, so that the printing is effected independently of the type-wheel magnet, but switches or polarized bars might be employed to direct the current through the magnet employed to shift the type-wheel, if desired. The type-wheel shifting-magnet *l* is provided with an armature and lever, *m*, the upper end of such lever being connected with the type-wheel sleeve by a fork and groove or other convenient means. When the magnet *l* is energized it shifts the type-wheels in one direction by sliding them endwise of the shaft, but when the electro-magnet *l* is not energized the spring *n* returns the parts to their former position. The magnets *l* and *f* are shown in the same electric circuit, and the magnet *l*, acting the most slowly, may hold the parts in position while the type-wheel is being set. Hence the impression will be on the letter-wheel *a*, with a closed circuit; but if the circuit of *l* is opened the type-wheels will be moved endwise, and bring the figure-wheel *b* into position for printing. If the ratchet and pawls forming the step-by-step movement are constructed to move one-half a tooth at each vibration in opposite directions, then the types on one wheel will have to be in line with the spaces in the other.

I claim as my invention—

1. Two type-wheels, sliding endwise of the shaft, in combination with an electro-magnet, to move such type-wheels in one direction, and a spring, or its equivalent, to return the type-wheels to their former position, substantially as set forth.

2. An electro-magnet in the same circuit as the printing-magnet, and operating to give end motion to two type-wheels when the circuit is closed, in combination with a magnet in a separate circuit, to give the impression, substantially as set forth.

Signed by me this 9th day of May, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

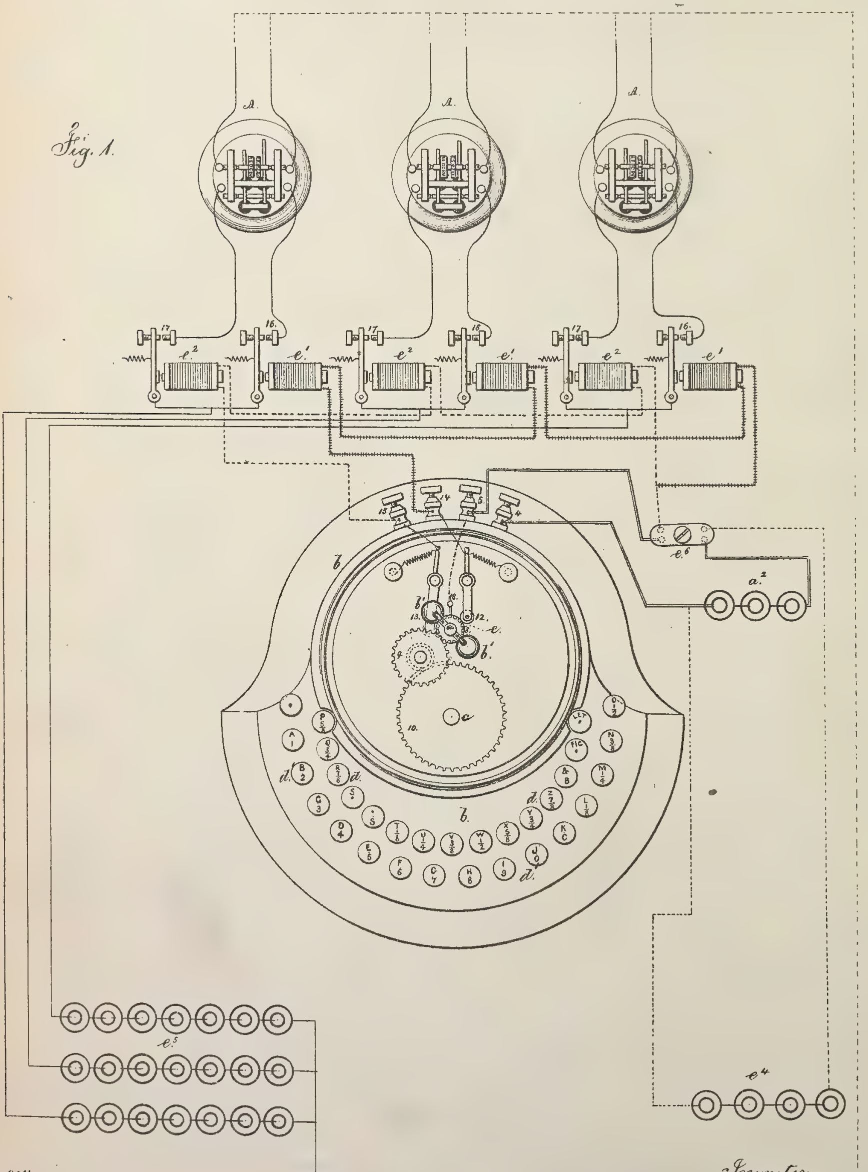
2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Transmitters and Circuits for Printing-Telegraphs.

No. 131,343. Patented Sep. 17, 1872.

Fig. 1.



Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thos. A. Edison,
Lemuel W. Serrell
Atty

2 Sheets--Sheet 2.

T. A. EDISON.

Improvement in Transmitters and Circuits for Printing-Telegraphs

No. 131,343. Patented Sep. 17, 1872.

Fig. 3.

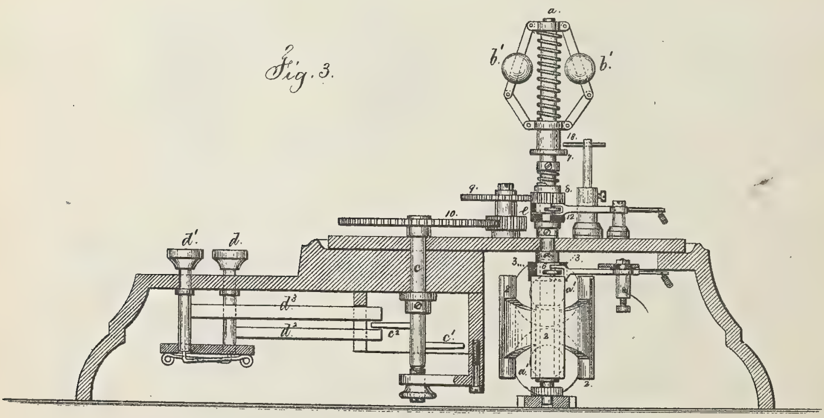
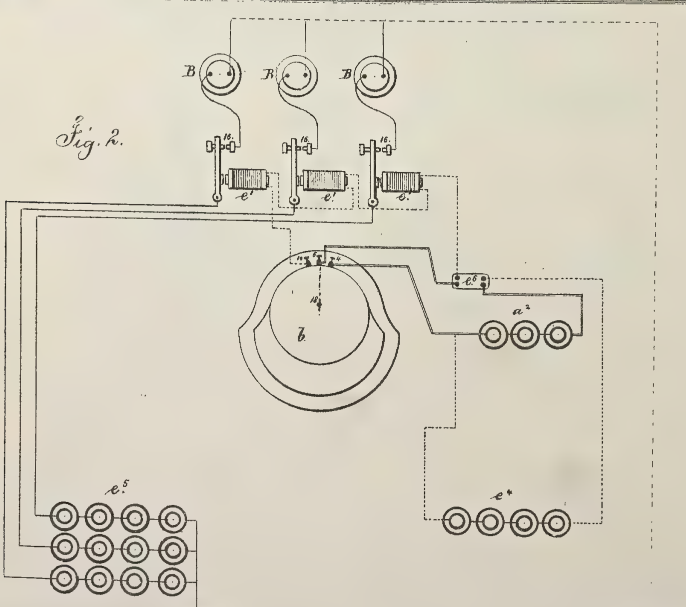


Fig. 2.



Witnesses

Chas H Smith

Harold Serrell

Inventor.

Thos. A. Edison,

Lemuel W. Serrell

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN TRANSMITTERS AND CIRCUITS FOR PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,343**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Newark, in the State of New Jersey, have invented an Improvement in Printing-Telegraphs, and the following is declared to be a correct description of the same.

The first part of this improvement relates to a machine that is termed a "transmitter," in which there are finger-keys or stops that are alloted to the respective characters employed. There is also in this instrument a "pulsator," that makes and breaks an electric circuit passing through a range of relay-magnets and opens and closes these until the pulsator is stopped by the depression of one of the finger-keys. The second part of this invention relates to the arrangement of the respective electric circuits that connect this transmitter with the relay-magnets and the circuits that are operated by those relay-magnets and pass through the printing-telegraph instruments, a number of these instruments being placed in each circuit, so that one transmitting instrument will operate in unison any number of printing-telegraph instruments to the extent of hundreds, and in case of defect in any one local circuit the other circuits will not be disarranged.

In Figure 1 a plan of the transmitter is shown, also a diagram representing the circuits to the relay-magnets and printing instruments, in which two wires are employed, one wire and circuit to the type-wheel magnets, the other to the printing-magnets. In Fig. 2 a diagram is shown of the transmitter and circuits to printing-telegraph instruments, operated by one wire and electric circuit; and Fig. 3 represents the transmitting instrument by a vertical section.

The shaft a of the transmitting instrument is preferably revolved by magnetism. For this purpose two stationary magnets are used, one of which, a^1, is seen in Fig. 3; and there are three armatures, 2 2 2; and upon the shaft a is a circuit-breaker, 3, of alternate conducting and non-conducting material, that opens and closes the circuit to the magnets a^1 alternately, so as to attract the armatures successively and revolve the shaft a. The battery a^2 operates this motor, the wires being connected at 4 to the bed b of the machine, and at 5 to the insulated binder, and from that to the magnets a^1 and to the lever and roller 6 of the respective pulsators, thence through the shaft a and bed b to 4. Upon the shaft a are governor-balls b', that rise by increased speed and bring the flange 7 of the sliding sleeve into contact with the adjustable insulated arm 18, Fig. 3; and from this a wire connects with 5, thereby the electricity will be "short circuited," passing through 4, b, a, 7, 18, and 5, instead of going through the electro-magnets a^1, thus lessening the power and the speed, and maintaining uniformity in the revolution of the motor. By the gearing 8 9 10 the shaft c is revolved with the desired speed. It has two arms, c^1 c^2, on opposite sides, one above the other, and these act in connection with the two semicircular ranges of finger-keys d d^1. Beneath the bed b these finger-keys have arms d^2 d^3 converging toward the center of c, and when one of the keys d^1 is depressed its arm d^3 stops the arm c^2, shaft c, and gears 8 9 10. The gear 8 is driven by friction, hence the motor and shaft a continue to revolve; but connected with the gear 8 is a pulsator, e, made of alternate conducting and non-conducting surfaces, and these open and close the circuits to the distant printing instruments or to the relay-magnets. By bearing in mind that the parts are made so that the pulsator e transmits the necessary number of pulsations to make a complete revolution of the type-wheels at the distant instruments by a step-by-step movement, each complete revolution of the shaft c, it will be understood that the shaft c and the type-wheels revolve in harmony, and that when the shaft c is stopped by one of the keys d or d^1 the type-wheels of the distant instruments are stopped, and the position of the characters on the type-wheels must be in harmony with the arrangement of the keys d d^1, and when the key is liberated the shaft c and pulsator e resume their revolution, and the distant type-wheels also resume the synchronous movement. The printing-telegraph machines illustrated at A A are operated by two wires. Those shown at B B, Fig. 2, are operated by one wire; hence with two-wire instruments two ranges of relay-magnets, e^1 e^1 and e^2 e^2, will be required, while only the range e^1 of relay-magnets will be needed with one-wire instrument. When two ranges of relay-magnets are used there are two rollers, 12 and 13, on insulated spring-levers. One is connected to the binding-screw 14, the other to the binder 15, and the parts are po-

sitioned so that the pulsator e, as it revolves, opens and closes the circuit from the battery e^4 through the relay-magnet e^1 to make and break the circuits at 16, from the batteries e^5 through the type-wheel electro-magnets in the distant instruments A. The relay-magnets e^2 will not respond although the circuit is closed by the roller 13, because the springs of the armatures of the electro-magnets e^2 are under considerable tension; but when the pulsator e is stopped by depressing one of the keys the roller 12 rests upon a non-conducting surface, breaking the circuit through e^1, and the roller 13, resting on a conductor, closes the circuit through the relays e^2, causing them to close the circuits at 17 of the batteries e^5; hence they act in the distant instruments A in the electro-magnets that effect the printing. The pulsator e, when employed with the single range of relay-magnets e^1, as in Fig. 2, causes the pulsations to be repeated at 16 from the batteries e^5 to the distant instrument, and when the printing is effected by a pause on a closed circuit, the pulsator e is stopped with the roller 12 in contact with the metallic portion of the pulsator; but if the printing is effected by a pause upon an open circuit the roller 12 is in contact with a non-conducting portion of the pulsator e. I have shown the battery e^5 in three sections connected with the respective relay-magnets and with three relay-circuits. In each of these relay-circuits there may be any desired number of printing-telegraph instruments, and the circuits are completed through the ground connections. The circuits to the transmitting instrument and the relay-magnets may be disconnected by a switch at e^6, that may be turned around to throw both batteries out of action, and the circuits from the batteries e^5 will also be broken at the relay-magnets.

I claim as my invention—

1. The pulsator e, driven by friction, in combination with the ranges of finger-keys and the arms c^1 c^2, substantially as and for the purposes set forth.

2. The revolving pulsator e in combination with the relay-magnets and connections of the local and main-line circuits, substantially as set forth, for actuating the printing-telegraph instruments in their respective circuits, substantially as set forth.

3. The governor b' and flange 7, in combination with the circuit connections to the magnets of the motor, substantially as and for the purposes set forth.

Signed by me this 10th day of June A. D. 1872.

T. A. EDISON.

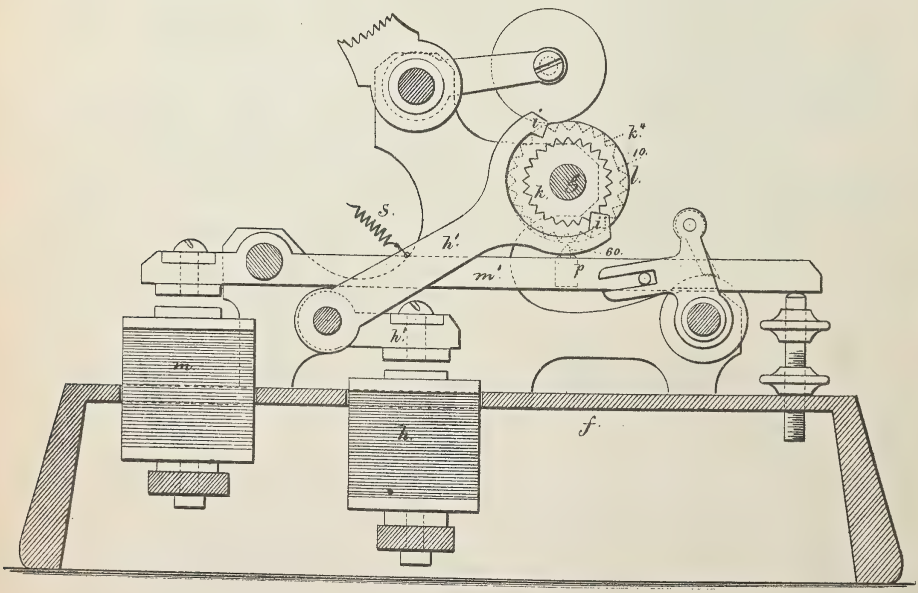
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Unison-Stops for Printing-Telegraphs.

No. 131,344. Patented Sep. 17, 1872.

Fig. 1.



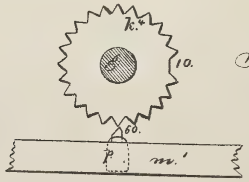


Fig. 2.

INVENTOR
Thomas A. Edison,
Per. Lemuel W. Serrell
ATTY.

Chas. H. Smith
Harold Serrell
Witnesses.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN UNISON-STOPS FOR PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,344**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

This invention is devised for rotating the type-wheel around to a unison-point by the action of a wedge-shaped tooth on the printing-lever operating upon a toothed wheel on the type-wheel shaft; thereby a number of machines in an electric-circuit are brought to a unison-point by pulsations through the printing-lever.

In the drawing, Figure 1 is a section showing the type-wheel and wedge-acting escapement, and Fig. 2 is a detached view of the unison-wheel and tooth.

The bed *f*, type-wheel *l*, shaft *g*, printing-magnet *m*, type-wheel magnet *h*, and printing-lever m', are of the usual character. The wedge-acting pallets *i i* of the type-wheel lever h' act upon the ratchet-wheel *k*, and give the type-wheel *l* a progressive movement, step by step, the pallets *i* being placed so that the type-wheel is moved half a space as the magnet *h* is energized, and the other half space is moved by the spring *s* acting upon the lever h', when the pulsation in *h* is arrested. Upon the printing-lever m' is a pallet or tooth, 60, and upon the type-wheel shaft *g* is a toothed wheel, k^4, with one tooth removed at the point where the type-wheels will be brought into unison.

The operation is as follows: Ordinarily the impression from the type-wheel by the printing-pad *p* will be made when the circuit through *h* is broken, and the parts in the position shown in Fig. 1, in which case the tooth 60 moves in between the teeth of k^4 without acting to turn the same; but when the machines are to be brought to unison, the circuit through *h* is kept closed, and the pallet *i* moves the type-wheel *l* and wheel k^4 half a space, so that the latter is in the position to the tooth 60, shown in Fig. 2; the printing-magnet *m* is then energized by a series of pulsations, and as the printing-lever m' moves, the tooth 60 rotates the wheel k^4 and type-wheel *l* around until the space 10, formed by the removal of one of the teeth of k^4, reaches the tooth 60, and hence there can be no further motion of the type-wheel, because the tooth 60 has nothing to act against, and thereby the type-wheels of the various printing-telegraph machines in the line will all stop when they arrive at the unison-point, even though the levers m' are still operated to bring into unison any type-wheels that may not have arrived at that point. During these motions, the upper pallet *i* yields as the shaft *g* and wheel *k* are turned, and this pallet *i* acts as a pawl to prevent a reverse movement. The type-wheel will not be printed from in these movements, because the pad *p* is brought up at the space between one type and the next, the pallets *i* being in the reverse position to that occupied by them when the printing is effected.

I claim as my invention—

1. The wheel k^4 and tooth 60, actuated by the printing-lever m', in combination with the type-wheel *l*, wheel *k*, and pallets *i*, substantially as and for the purposes set forth.

2. Adjusting the type-wheel to the unison-point by the movement of the printing-lever while the type-wheel pallets are in the opposite position to that which they occupy when the type-wheel is being printed from, substantially as set forth.

Signed by me this 29th day of June, A. D. 1872.

T. A. EDISON.

Witnesses:

GEO. D. WALKER,

GEO. T. PINCKNEY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PAPER FOR CHEMICAL TELEGRAPHS, &c.

Specification forming part of Letters Patent No. **132,455**, dated October 22, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Preparing Chemical Paper or other material for telegraphic purposes; and the following is declared to be a correct description of the same.

Before my invention iodide of potassium had been employed in the preparation of chemical paper for receiving telegraphic communications by dots and dashes, and starch had been mixed with this solution of iodide of potassium to cause its adhesion to the paper. In receiving telegraphic communications, while the paper remained damp, this operated very well, but when the paper became dry the starch was liable to crack and peel off.

My invention is made to avoid the before-named difficulty, by using a vehicle for the iodide of potassium that will not crack or scale off the paper when dry. In order to make use of the starch in the solution, it is necessary to use hot water or to boil the same, otherwise the starch will not remain with uniformity throughout the solution during the soaking operation to which the paper is subjected.

I have discovered that a very thin paste made of flour and water will retain the iodide of potassium uniformly in solution during the soaking operation to which the paper is subjected; it will not make the paper hard or brittle, but will penetrate the fabric, and no portion of the surface will crack or scale off when the paper becomes dry. Furthermore, during the time that the paper is kept moist ready for use, there is but little tendency to deteriorate or become injured by atmospheric influences, especially if kept in tin cans or jars, and if the paper becomes too dry it can easily be remoistened.

I prefer that the flour and water be mixed together while the water is warm, and, I remark, that fine wheat flour is the best, but rye or other flour may be employed.

I claim as my invention—

The chemical paper for telegraphic purposes, prepared in the manner specified.

Signed by me this 10th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:

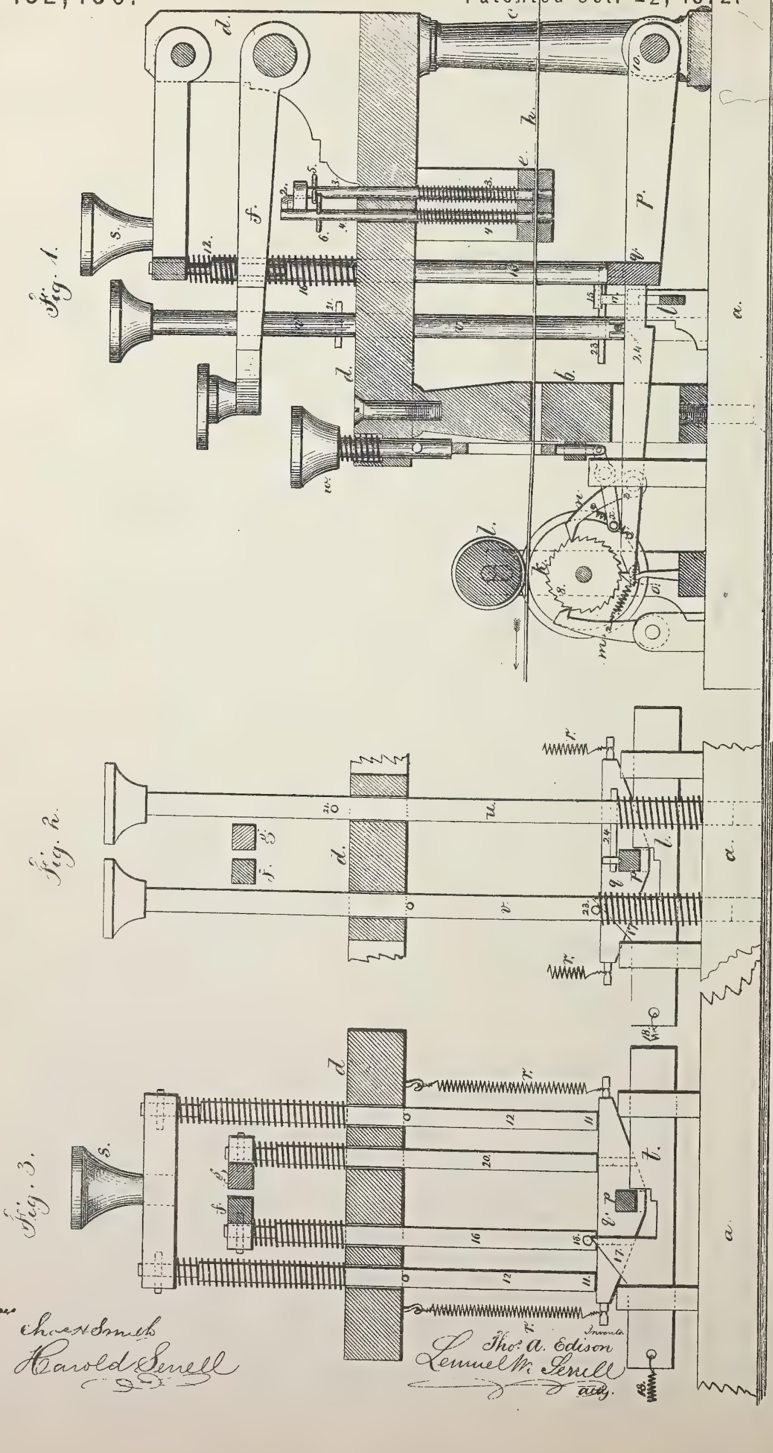
GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Apparatus for Perforating Paper for Telegraphic Use.

No. 132,456. Patented Oct. 22, 1872.



Witnesses
Chas. H. Smith
Harold Serrell

Thos. A. Edison
Inventor
Lemuel W. Serrell
atty.

2 Sheets--Sheet 2.

T. A. EDISON.

Improvement in Apparatus for Perforating Paper for Telegraphic Use.

No. 132,456. Patented Oct. 22, 1872.

Fig. 5.

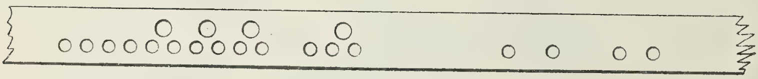
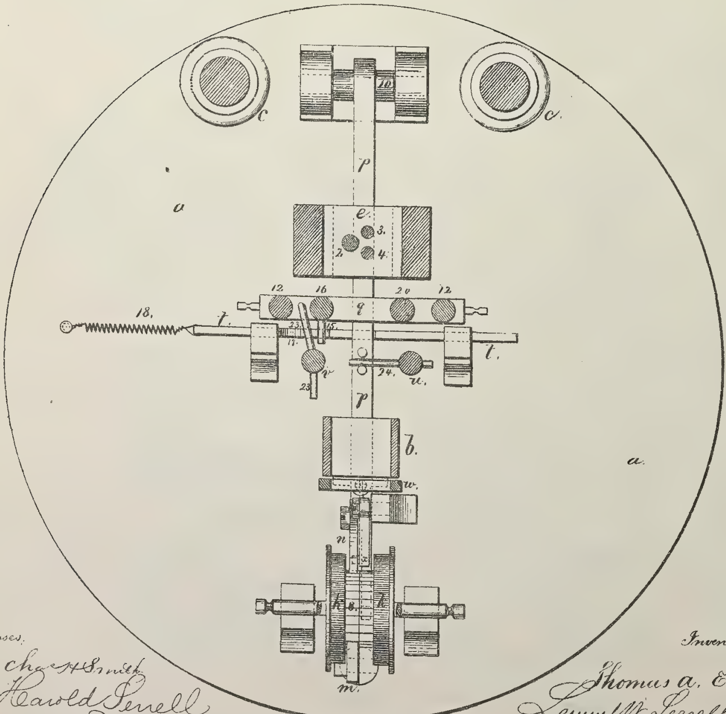


Fig. 4.



Witnesses:
Chas H Smith
Harold Serrell

Inventor
Thomas A. Edison
Lemuel W. Serrell
atty.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN APPARATUS FOR PERFORATING PAPER FOR TELEGRAPHIC USE.

Specification forming part of Letters Patent No. **132,456**, dated October 22, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Perforating-Machines, and the following is declared to be a correct description of the said invention.

The strip of paper is perforated by this machine for use in transmitting telegraphic messages. The machine is made with keys that perforate either a single dot or three openings to form a dash, one of the three openings being larger than the others so as to produce a longer pulsation. The paper is fed the proper distance each perforation, and word-spaces, pauses, and sentence-spaces are produced by keys, and these keys are arranged in a small compass, and the instrument is compact, cheap, and adapted to local offices or to individual use.

In the drawing, Figure 1 is a vertical section centrally of the machine and in line with the strip of paper; Fig. 2 is an elevation of the spacing-bars for words and sentences; Fig. 3 is an elevation of the spacing-bars for the letters and pauses; Fig. 4 is a sectional plan at the plane of the paper; and Fig. 5 shows a piece of the perforated paper.

The bed *a* carries the standards *b c* and frame *d*. The die *e* is made with three openings, as in Fig. 4, for the three punches 2 3 4 that are raised by springs and depressed by the key-lever *f* so as to punch the three holes at once, or when the key-lever *g* is depressed only the punch 4 is moved. In Fig. 1 it will be seen that the lever *f*, acting on the upper end of 2, carries that down, and by the arm 5 and pin 6 the punches 3 and 4 are also moved, but the pin 6 being below the arm 5 the punch 4 can be moved down separately. The perforation from the punches 2, 3, and 4 represents a dash, and in consequence of the punch 2 being the largest it removes sufficient paper to insure a metallic contact of the brush or transmitting-stylus between one of the smaller perforations and the other, thereby producing a dash-mark. Upon each depression of the key *f* or *g* the paper-feeding mechanism is operated so that as the key is raised the feed takes place sufficiently to produce the required space between one letter and the next. The paper *h* passes above the die *e* and through the slotted standard *b* between the feed-roller *k* and holding-roller *l*. The roller *k* is made with the ratchet-teeth 8 in the middle, and *m* is the stop-pawl; *n*, the actuating-pawl on the lever *p*; and *o* is the stop or blocking pawl on the lever *p* taking the second range of reverse ratchet-teeth. The lever *p* has its fulcrum at 10, and receives more or less vibration according to the amount that the paper is to be fed. The yoke *q* and springs *r* serve to raise the lever *p* to its full height, as determined by the stops 11 on the rods 12, and these rods 12 extend to the key *s* that gives motion to the lever *p* sufficient to space off between one word and the next, as at a pause. The movement of the lever *p* is arrested by the notched slide *t*, see Fig. 3, and this slide *t* is moved endwise to bring a deeper notch below the lever *p* and allow greater motion when the dash key-lever *f* is depressed, because the pin 15 upon the slide-rod 16 running down the incline 17 on *t* moves the same endwise against the action of the spring 18, when the said key-lever *f* is struck. When the dot key-lever *g* is struck the slide 20 moves the lever *p* and feeds the paper the same distance as when the space-key *s* is depressed. The slide *u*, with a knob at its upper end, has a movement limited by the stop 21 and by the pin 24, moves the lever *p* and paper only a short distance, sufficient to separate one word from another, but the slide *v* with its pin 23 acting upon the incline 17, and also upon the yoke *q* of the lever *p*, depresses the latter to its full extent and feeds the paper a distance to denote the end of a sentence. In case the lever *p* should be depressed its full extent and it is desired to shorten the length of paper-feed the pawl *n* is lifted out of the ratchet-teeth 8 by the swinging finger and pin *x* that is actuated by the slide and key *w*, so that as the lever *p* rises the pawl will go forward and take the ratchet-teeth, but only move the feed-roller a short distance.

I claim as my invention—

1. Perforations for dashes in telegraphic transmitting-paper composed of two small and an intermediate large perforation, as specified.

2. A perforating mechanism composed of three punches in combination with two keys, arranged substantially as specified, so that all

three punches will be actuated by one key and only one by the other key, as set forth.

3. A feeding-roller actuated by a lever and pawl in combination with the perforating-punches and keys, and intervening mechanism for regulating the movement of the lever in proportion to the length of feed-movement required for the paper.

4. The notched slide *t* in combination with the lever *p* and keys for spacing the distance between the perforations, substantially as set forth.

5. The finger *x* actuated by the key *w* in combination with the pawl *n* and paper-feeding lever *p*, substantially as set forth.

Signed by me this 15th day of March, 1872.

T. A. EDISON.

Witnesses:

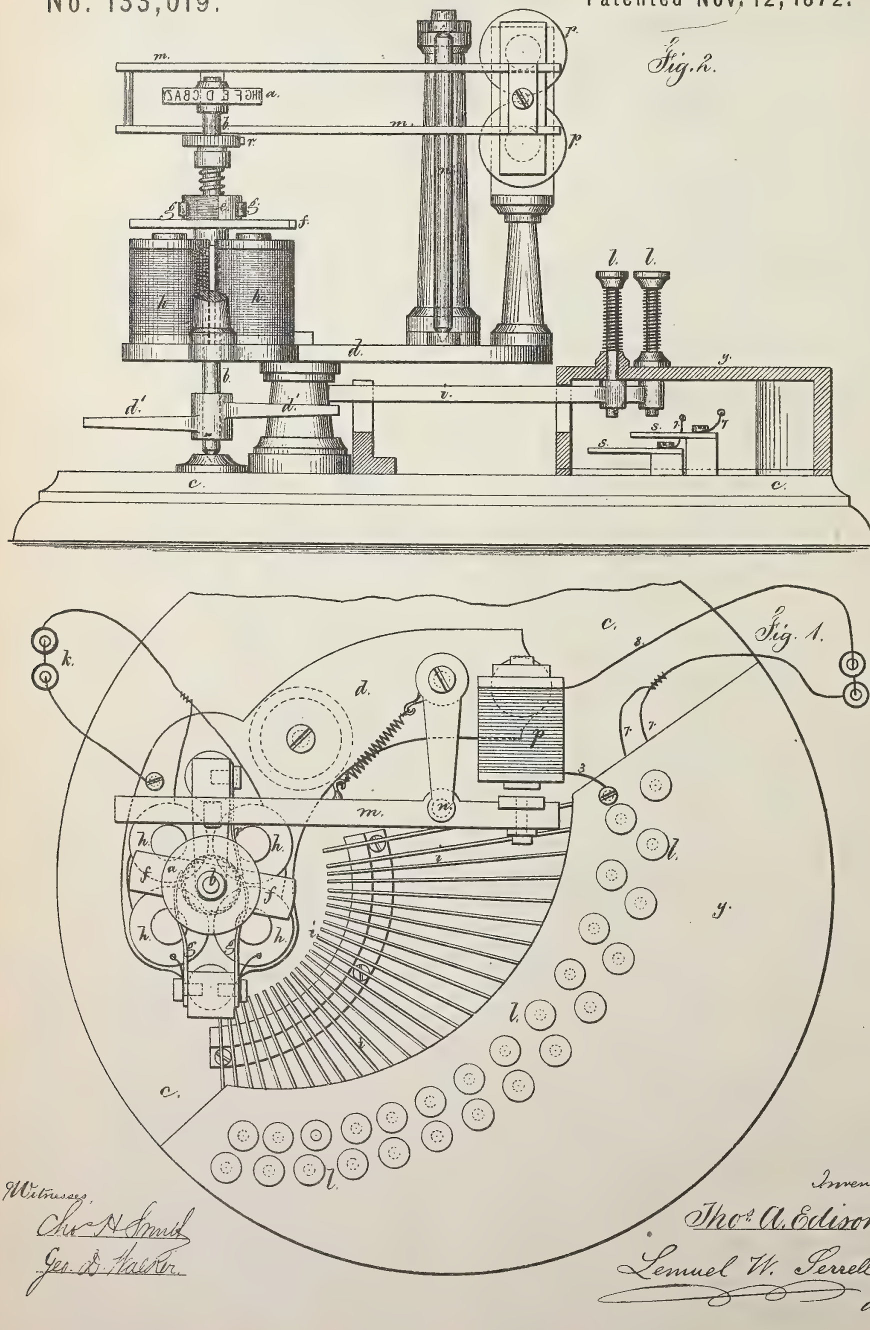
GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Improvement in Electrical Printing-Machines.

No. 133,019. Patented Nov. 12, 1872.



Witnesses

Chs. H. Smith

Geo. D. Walker

Inventor

Thos. A. Edison

Lemuel W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN ELECTRICAL PRINTING-MACHINES.

Specification forming part of Letters Patent No. **133,019**, dated November 12, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Electrical Printing-Machines; and the following is declared to be a correct description thereof.

This invention is intended for printing upon a strip or sheet of paper by a type-wheel, so that messages, instead of being written, can be printed off by touching finger-keys. The machine is also available for printing copies of documents or composing and printing instead of writing.

I make use of a type-wheel upon a shaft that also carries an armature and circuit-breaker that is driven by a magnetic motor, the said armature propelling the said shaft by frictional contact. Upon the shaft is an arm that is stopped by one of a range of keys, these being positioned so that the type-wheel, with the corresponding type, will be stopped at the position to be impressed. The depression of the finger-key completes a circuit to a magnet that gives the impression.

In the drawing, Figure 1 is a general plan of the machine; and Fig. 2 is an elevation, partially in section, of the same.

The type-wheel *a* is upon a shaft, *b*, in suitable bearings in the bed *c* and frame *d*. Affixed to this shaft *b* are also the arm or arms *d'* and the armature *f* and circuit-breaker *e* to the springs *g;* and this armature and circuit-breaker are connected to the shaft by a friction-coupling, so that they can easily revolve the shaft when free; but when the shaft is stopped the armature will continue to revolve. The electro-magnets *h* and the connections from the battery *k* to form, with the armature *f*, an electro-motor are known, and do not require further description. The finger-keys *l* are arranged so as to move a projection, *i*, to each key into the path of the arm *d'*, so as to arrest the movement of the arm and type-wheel when the former comes into contact with the projection *i* of the depressed key. These projections *i* are arranged circularly, and, if positioned in a circle, then only one arm, *d'*, will be required. If positioned in a half circle, they must be in two rows, one above the other, and two arms, *d'*, will be required, as shown. The printing-lever *m* is on a fulcrum, *n*, and is operated upon by the magnet *p*, the connection for this magnet from the battery *q* being completed by the depression of the finger-key, causing the slide-rod of said key to stop upon the insulated plate *s*, one pole of the battery being connected therewith by the wire or wires 7, and the other, by the wire 8, to the magnet *p;* and from the latter there is a connection, 3, to the metallic plate *y* carrying the keys *l*. The impression-lever is made with any suitable feeding device for moving a strip of paper along or presenting a sheet, line after line, to the type-wheel.

It will now be understood that the magnetic motor maintains a rapid rotation of the type-wheel until one of the keys is depressed, which arrests, by its projection *i*, the arm *d'* and type-wheel, the latter having a corresponding letter opposite the impression-pad, and instantly the impression is given by the action of the electro-magnet *p*.

A stop-pawl, *r*, prevents any risk of rebound when the arm is arrested by the stop *i*.

I claim as my invention—

1. The type-wheel and shaft, revolved by friction from the armature of an electro-motor placed upon the type-wheel shaft, substantially as set forth.

2. The finger-keys *l* and electro-magnet *p*, connected as set forth, in combination with said type-wheel and the impression-lever, substantially as specified.

Signed by me this 18th day of April, 1872.

T. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

3 Sheets--Sheet 1.

T. A. EDISON.

Type Writing-Machine.

No. 133,841. Patented Dec. 10, 1872.

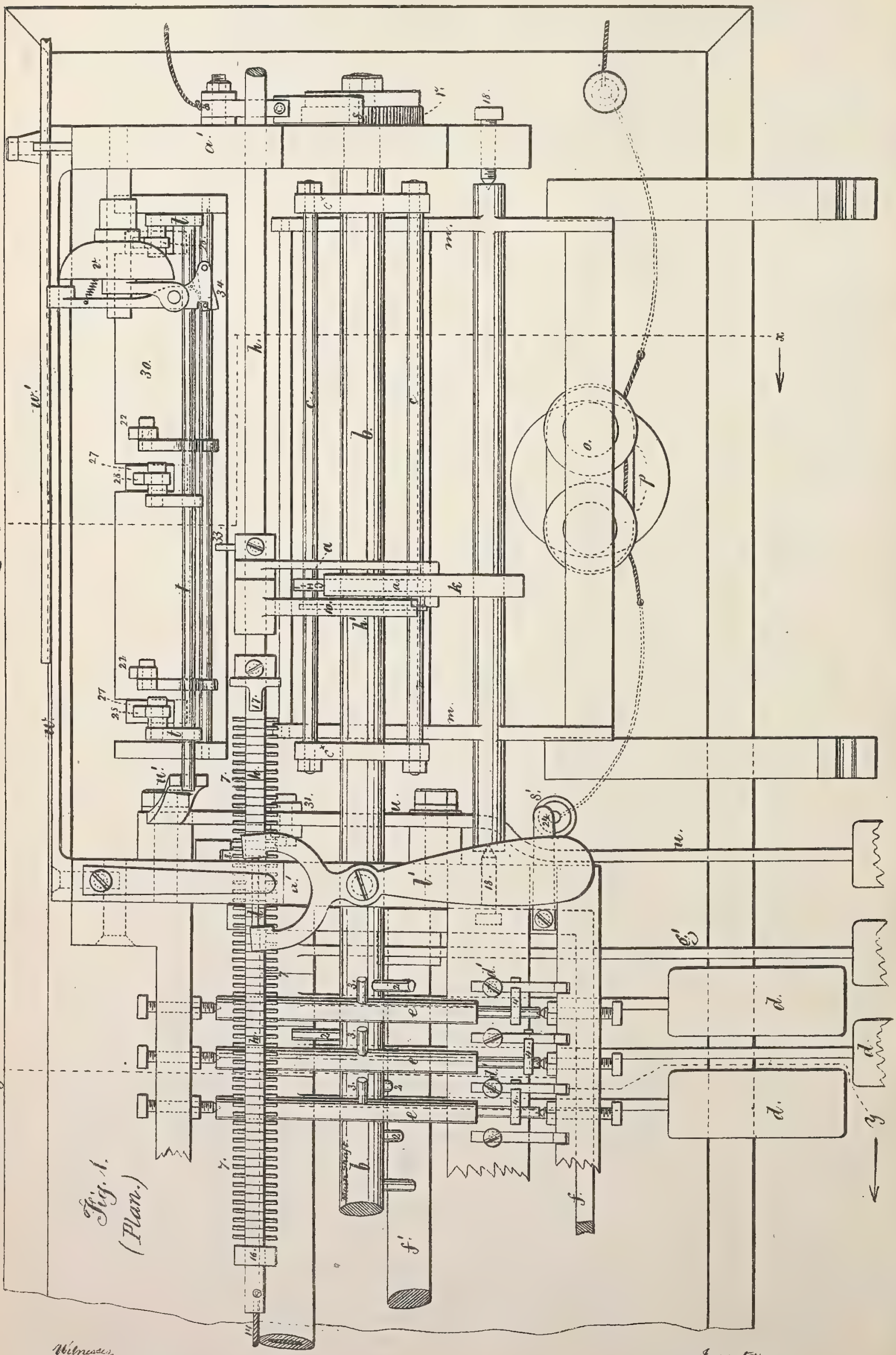


Fig. 1. (Plan.)

Witnesses
Chas. H. Smith
Geo. D. Walker

Inventor
Thos. A. Edison
L. W. Serrell — atty.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

3 Sheets--Sheet 2.

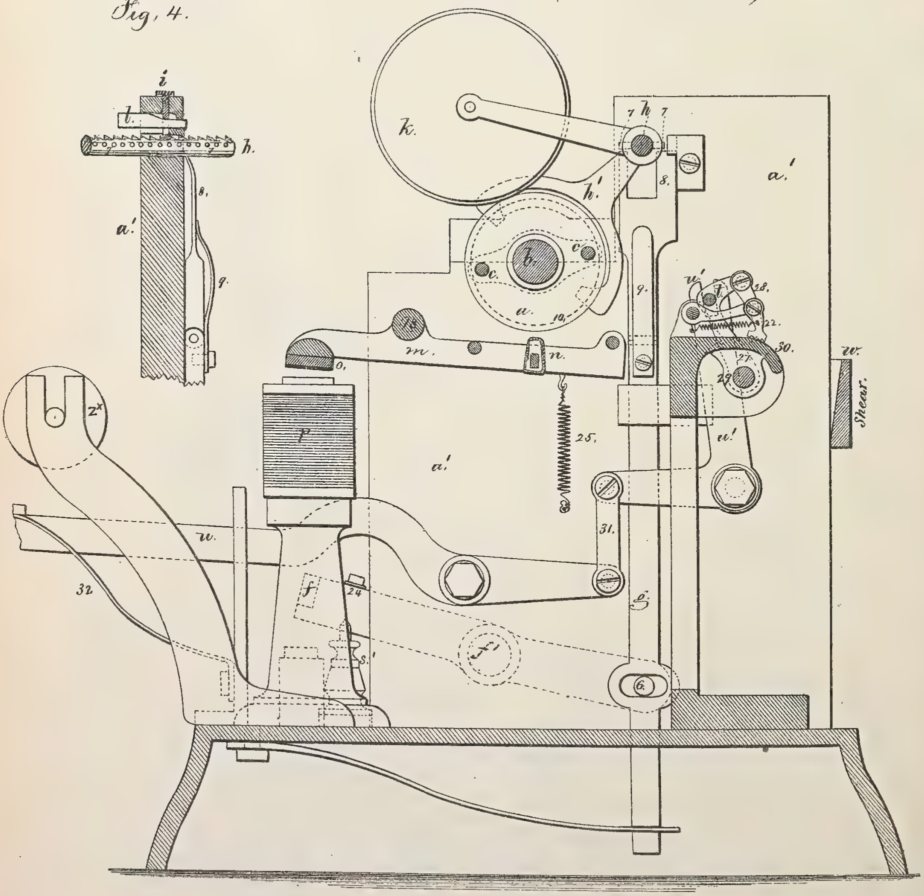
T. A. EDISON.

Type Writing-Machine.

No. 133,841. Patented Dec. 10, 1872.

Fig. 4.

Fig. 2.
(Section on x,x,)



Witnesses
Chas H. Smith
Geo. D. Walker

Thos. A. Edison
Lemuel W. Serrell
atty

3 Sheets--Sheet 3.

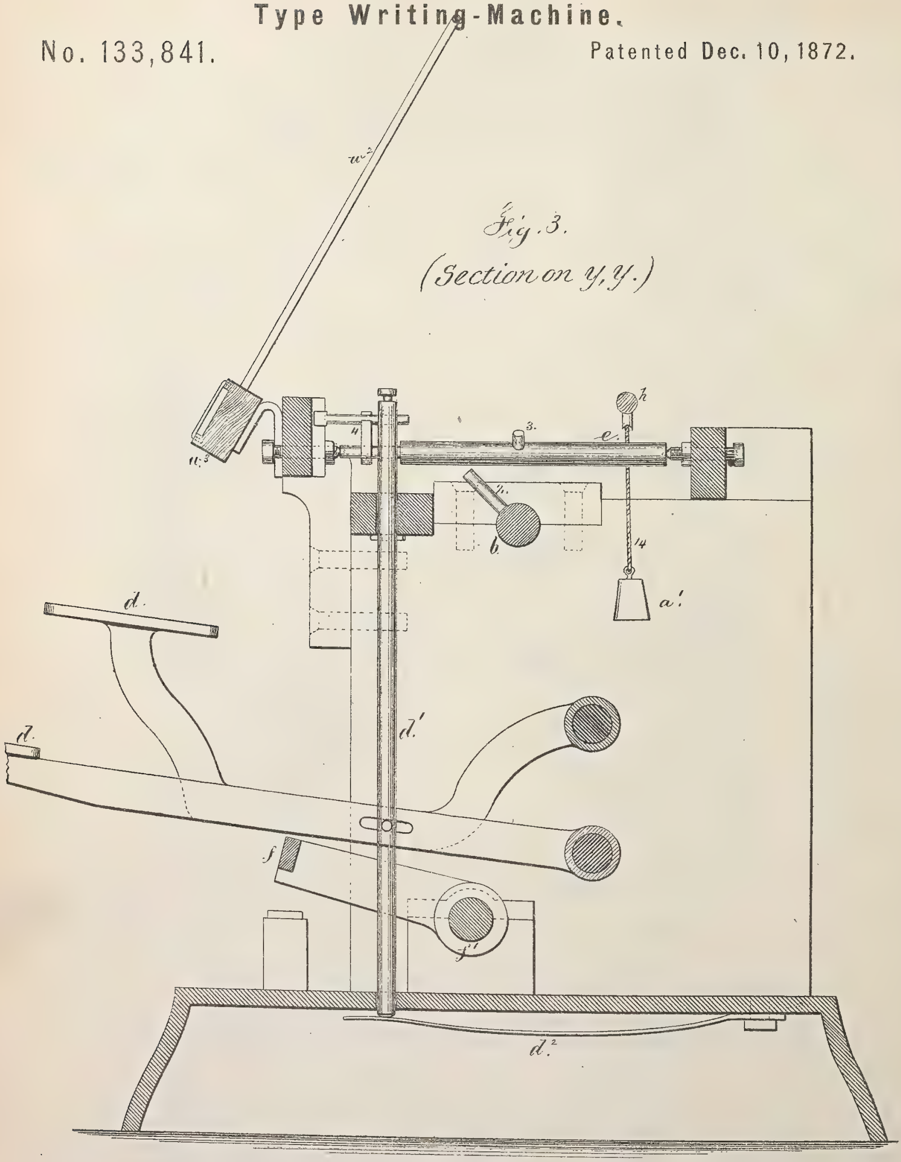
T. A. EDISON.

Type Writing-Machine.

No. 133,841. Patented Dec. 10, 1872.

Fig. 3.

(Section on y, y.)



Witnesses

Chas. C. Smith

Geo. D. Walker

Thos. A. Edison

Lemuel W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN TYPE-WRITING MACHINES.

Specification forming part of Letters Patent No. **133,841**, dated December 10, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Machines; and the following is declared to be a correct description of the same.

This invention is for printing by a type-wheel in a line upon a sheet or web of paper and then moving such paper along so as to print upon the line below. This invention is divided into the following principal features: First, mechanism for arresting a revolving type-wheel with the designated letter in position to be printed; second, the means for moving the type-wheel along between one impression and the next; third, mechanism for bringing the type-wheel back from the end of one line so as to commence at the beginning of the next; fourth, the devices for impressing the paper on the type-wheel; fifth, the feeding devices that move the paper the distance between one line and the next.

By moving the type-wheel along the line and across the paper the parts are simplified and rendered more compact than in those machines in which the paper has been moved; hence a roll or web of paper can be employed, and a telegraphic message printed thereon by hand, and cut off, instead of writing out the same, as now usual.

In the drawing, Figure 1 is a plan of the operative parts of the machine and part of the keys. Fig. 2 is a section at the line *x x*, near the type-wheel. Fig. 3 is a section at the line *y y*, representing the keys.

The type-wheel *a* is upon a sleeve that can be slipped endwise upon the shaft *b*. The guide-rods *c c* that are secured to heads upon the shaft *b*, and are paralled to such shaft, pass through holes in the type-wheel, and serve to rotate the type-wheel, but they do not interfere with the movement of the type-wheel and its sleeve endwise of the shaft by the means hereafter stated. The shaft *b* is of any desired length so as to pass over the range of finger-keys, and this range of finger-keys has the letters or characters corresponding to those on the type-wheel, and also the necessary keys for spaces between words and for moving the paper along from one line to the next. A pulley, continuously revolving by competent power, is applied to the shaft *b*, and an interposed friction allows the wheel to continue its revolution while the shaft and type-wheel are stopped. Upon the type-wheel shaft *b* are projecting pins or blocks 2, arranged spirally, or positioned so that when the stop-pin 3 is brought into the path of such block 2 the shaft *b* will be arrested by such pin 3, with the letter or character corresponding with the key depressed in position for printing.

The means for moving the pin 3 by the key might be varied; but I have shown the key *d* as acting upon a vertical bar, d^1, that has a pin acting in a cam-jaw, 4, upon the shaft *e* that carries such pin 3; hence, upon the depression of any one key the pin 3 connected with that key will be moved into the path of the block 2 upon the shaft *b*, and properly stop the type-wheel.

Springs d^2 are employed for raising the keys, and the key will rise slightly without liberating the block 2, in order that there may be time for the paper to be drawn away from the type, as hereafter described, before the type-wheel is again revolved. The finger-keys, for convenience, may be in two ranges, as shown. Beneath the range of finger-keys is a bar, *f*, supported by arms from the shaft f^1, so that when any one of the finger-keys is depressed the bar *f* will be moved, and, by the arm and pin 6, operate the feeding-bar *g*, which is made as a forked inclined pawl, 8, (see Figs. 2 and 4,) at the upper end, that is pressed between the spacing-pins 7 on the rack-bar *h*, and moves such rack-bar and the type-wheel along one space each time a key is depressed, and a spring, 9, allows this pawl 8 to yield as the bar *g* descends, and then springs back so as to take behind the next spacing-pin. (See Fig. 4.) The lever g' is placed above, as a finger-key, or connected with the bar *f* so that the pawl 8 can be operated to move the rack-bar and type-wheel between one word and the next without striking either of the letter-keys *d*. The rack-bar *h* is made to slide in the frames a' a', and is provided with a forked arm, h', that sets over the edges of a disk, 10, that is connected with the type-wheel *a*, so that said type-wheel *a* will be free to revolve, but will be moved along upon the shaft *b*, as aforesaid, by the rack-bar *h*. This rack-bar *h* carries, also, the inking-roller or wheel *k* that supplies the necessary ink to the type. In the surface of the rack-bar *h* are notches, and a spring-pawl,

i, is provided to take into these and hold the rack-bar as moved along by the pawl 8. (See detached view, Fig. 4.) At one end of the rack-bar *h* a cord or chain, 14, is attached, passing over a pulley to a weight, and this weight is sufficient to draw the rack-bar and type-wheel along when the pawl *i* is raised. As the type-wheel reaches the end of the line a projection, 16, on the rack-bar *h* slides a wedge, *l*, under the pawl *i*, lifting the same and allowing the weight to draw the rack-bar and type-wheel back to the commencement of the line, and as this movement is finished the projection 17 moves the wedge *l* away from the pawl *i*, allowing said pawl to become again operative. This wedge *l* can be operated by the hand-lever *l′* so as to return the type-wheel to the beginning of the line between one paragraph and the next. The device for giving the impression consists in a padded bar, *n*, beneath the type-wheel, and set in a frame, *m*, that is hung on centers 18, and carries the armature *o* of the electro-magnet *p*, and this electro-magnet gives the impression whenever the type-wheel is stopped by the depression of a key. The electrical connections for this magnet consist of a break-wheel, *r*, revolved with the type-wheel *a*, and having as many conducting and non-conducting spaces as there are spaces on the type-wheel, and the spring-tooth *s* rests upon the same, and is in the electric circuit. This circuit passes, also, through the magnet, as shown in Fig. 1, and to the insulated post *s′*; and upon the end of the bar *f* there is a spring-finger, 24, that touches the end of this post *s′* when the key is depressed; hence the circuit will be closed at this point, but the electro-magnet *p* will not become charged until the type-wheel stops, because the break-wheel *r* opens and closes the circuit too rapidly; but when the type-wheel stops, the tooth *s* being on one of the conductors of that break-wheel, the circuit remains closed long enough for the magnet *p* to act and give the impression. The shaft *b* and bed of the machine form part of the electric circuit to the spring-finger 24. The circuit will be broken at *s′* as the key rises and before the type-wheel is allowed to revolve, so that the spring 25 may draw away the impression-bar and paper and prevent the printing being blurred. A suitable stop limits the motion. The feeding device that moves the paper along from one line to the next consists in the spring-pawls 28, hinged to a frame, *t*, that swings on the shaft 29, and said pawls hold the paper against the swinging segments 27 in moving such paper, but draw over the surface in the backward movement, the paper being held at this time by the pawls 22 against the stationary table or shield 30. The key *u*, connection 31, and lever *u′* are used for moving the frame *t* and feeding the paper forward from the reel or drum *z**, and a spring, 32, returns the parts to their normal position. An alarm-bell, *v*, is employed to call the operator's attention to the line being finished, said bell being struck at the last or nearly the last movement of the rack-bar *h*, by a projection, 33, moving the tail of the hammer 34. The operator moves the paper forward at the proper time by depressing the key *u*; or it might be done automatically by a connection from the rack-bar as the type-wheel is drawn along. In order to cut off a piece of paper upon which the printing has been done I provide a stationary shear, *w*, and swinging shear w^1, the latter being kept open by a spring so as not to interfere with the paper as it is fed along. A rack or stand, w^2, should be supported above the finger-keys on the frames *a′ a′*, to hold the manuscript to be copied from, and a grooved bar, w^3, Fig. 3, may also be provided in which a strip of paper may lie, this strip having upon it telegraphic characters in dots and dashes, either indented in the paper or made in colors in chemically-prepared paper, so that this may be drawn along in said bar as the message is printed.

I claim as my invention—

1. A type-wheel moved along in the line of its axis by a progressive movement between one impression and the next so as to print from such type-wheel in a line, substantially as set forth.

2. The rack-bar *h* and spacing-pins 7, in combination with the spring-pawl 8, key *d*, and type-wheel *a*, substantially as set forth.

3. The pawl 8, in combination with the rack-bar *h*, disconnecting device *i l*, and stops 16 and 17 upon such rack-bar *h*, substantially as and for the purposes specified.

4. The lever *l′* and disconnecting device *i l*, in combination with the rack-bar *h* and type-wheel *a*, substantially as set forth.

5. A pressure-bar sustaining the paper to be impressed below the line of printing, in combination with a type-wheel moved endwise of the axis, progressively, between one impression and the next, substantially as specified.

6. The break-wheel *r*, spring-finger *s*, and electric circuit and circuit-breaker 24 *s′*, in combination with the type-wheel, impression-bar, and electro-magnet, substantially as and for the purposes set forth.

7. The paper-feeding pawls 28 swinging with the segments 27 upon the shaft 29, in combination with the pawls 22 and stationary bed 30, as and for the purposes set forth.

8. A type-wheel and mechanism for moving the same in the direction of its axis between one impression and the next, in combination with impression mechanism and with a paper-feed actuated between one line of printing and the next, substantially as specified, so that printing can be done line after line across a roll or web of paper, substantially as set forth.

Signed by me this 13th day of November, A. D. 1871.

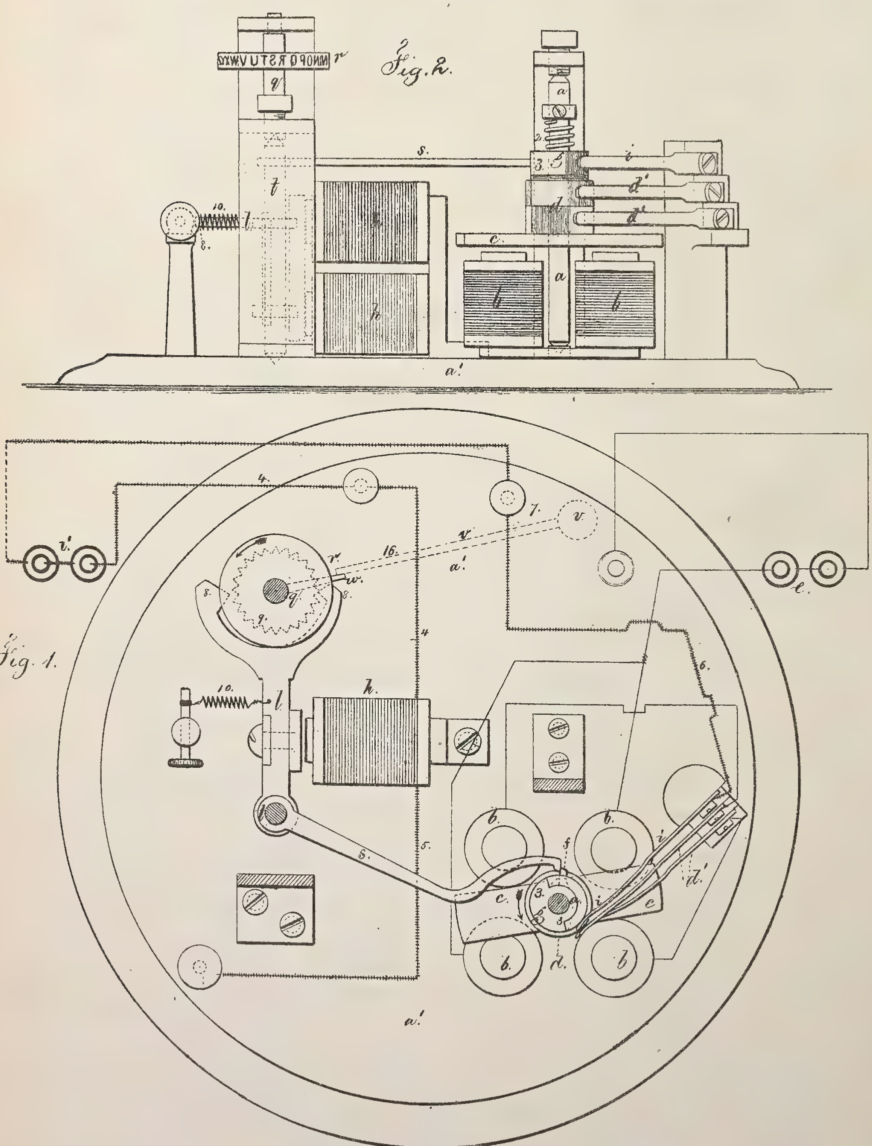
T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

Printing Telegraph Instruments.

No. 134,866. Patented Jan. 14, 1873.



INVENTOR

Thos. A. Edison

Per. Lemuel W. Serrell ATTY.

Chas H Smith

Harold Serrell

Witnesses.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. **134,866**, dated January 14, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented certain Improvements in Telegraph Instruments, of which the following is a specification:

This instrument is adapted to receiving and transmitting; and the transmitter is somewhat similar to that shown in Letters Patent granted to me January 23, 1872, No. 123,005, there being a pulsator upon a revolving shaft to open and close the main circuit as in said patent, and the pulsations operate through a magnet in the transmitter, and also in the receiving-machines to rotate their respective type-wheels by a step-by-step movement.

My present improvement relates only to the transmitting portion of the instrument; and the same consists of means for arresting the movement of the pulsator, when a finger-key is depressed for the purpose of breaking the circuit to the type-wheel magnets, and stopping the type-wheels at a letter corresponding with the depressed key.

I make use of a stop-arm vibrated by the type-wheel lever to arrest the movement of the pulsator, and this stop-arm is vibrated clear of a pin upon the pulsator each time the pulsator opens the circuit to the type-wheel magnets, while said circuit is being opened and closed to send pulsations to rotate the type-wheels; but when a finger-key is depressed to stop said type-wheels, this stop-arm is kept in the path of the pin and stops the pulsator with a circuit-closer upon its non-conducting portion, which breaks the circuit to the type-wheel magnets, and arrests all the type-wheels at the same point. When the key is liberated the type-wheel lever, by its spring, moves the stop-arm from the pin, and allows the pulsator to revolve with its shaft and open and close the main circuit, as before.

It is to be understood that in the receiving-machines this pulsator is stationary, the pulsations passing direct to the type-wheel magnets, energizing the same, and giving the step-by-step movement to rotate the type-wheels, and that the devices herein described are brought into action for transmitting from the machine sending the message.

In the drawing, Figure 1 is a sectional plan showing my improvements; and Fig. 2 is an elevation of the same.

The vertical shaft *a* is rotated continuously by the electro-motor, composed of the electro-magnets *b b*, armature *c*, circuit breakers and arms *d d'*, and connections to the battery *e*, all of which are of usual character. *g* is the pulsator, revolving by frictional contact with the shaft *a*, through the agency of the spring 2, and said pulsator is made with the conducting and non-conducting portions, as shown most clearly in Fig. 1; and *f* is a pin projecting from said non-conducting portion of *g*.

At each revolution of the pulsator *g* the circuit is opened and closed once to the type-wheel magnet *h*, the circuit being closed when the insulated arm *i* is in contact with the conducting portion 3 of the pulsator, and the pulsations pass by the wire 4 to said magnet *h*, and thence, by the wire 5, bed *a'*, shaft *a*, pulsator *g*, insulated arm *i*, and wire 6, to the insulated binder 7, to which the main-line wire is connected, and by this wire the pulsations pass to and through the type-wheel magnets of the receiving-machines at the distant stations, and return by the earth portion of the circuit. These pulsations act in the magnet *h* of the transmitter, and also in the same magnets of the receiving-machine, to rotate the type-wheels *r* by a step-by-step movement, by means of the lever *l*, pallets 8 8, and toothed wheel 9 upon the shaft *q*.

I will now describe how the pulsator is arrested in its movement to break the circuit to the type-wheel magnets and stop the type-wheels.

The finger-keys are in a semicircular range or ranges, as in aforesaid patent, and concentric with the shaft *q;* one of said keys is shown at *v* by dotted lines. *w* is an arm upon the shaft *q*. *s* is an arm upon the axis *t* of the lever *l*, and the outer end of said arm is contiguous to the pulsator *g* during each half revolution of said pulsator, when the circuit is closed to the type-wheel magnet *h*, and is moved away from the same by the back movement of the lever *l* during the other half revolution, when the circuit is broken to said magnet; hence said arm does not obstruct the movement of the pulsator while the circuit to the magnet *h* is being opened and closed to rotate the type-wheels. When a finger-key

is depressed its arm, 16, is brought in the path of the arm *w*, whose movement it arrests and stops the shaft *q*. The arm *w* is located with reference to the position of the teeth of 9, so that when said wheel is stopped it holds the lever *l* in the position shown in Fig. 1, with the stop-arm *s* in the path of the pin *f*, and said arm stops the pulsator with the circuit-closer *i* upon the non-conducting portion of the same, which breaks the circuit to the magnet *h*, and also to all the type-wheel magnets of the receiving-machines in the circuit, stopping their type-wheels at the same letter as the wheel *r*, and corresponding with the key depressed.

When the key is liberated the spring 10 completes the backward movement of the armature, type-wheel lever *l*, and pallets 8, giving a slight movement to the wheel 9, and also moving the stop-arm *s* sufficiently to liberate the pin *f* and allow the pulsator again to revolve with its shaft, and open and close the circuit to the type-wheel magnets, as before.

The printing lever and magnet are not shown in the drawing, but they may be of usual character, either for the transmitter or receiver, and be operated in any desired manner to effect the printing when the type-wheels are stopped.

I claim as my invention—

1. The stop-arm *s*, connected with the lever *l* and pallets 8, in combination with the pulsator *g*, and stop *f* for arresting the movement of the pulsator, substantially as set forth.

2. The type-wheel magnet *h*, in the circuit that is opened and closed by the pulsator *g*, in combination with a stop that arrests the movement of the pulsator when the circuit is broken, and a spring, or its equivalent, that liberates the pulsator upon completing the backward movement of the armature and pallets, substantially as set forth.

Signed by me this 16th day of October, 1872.

T. A. EDISON.

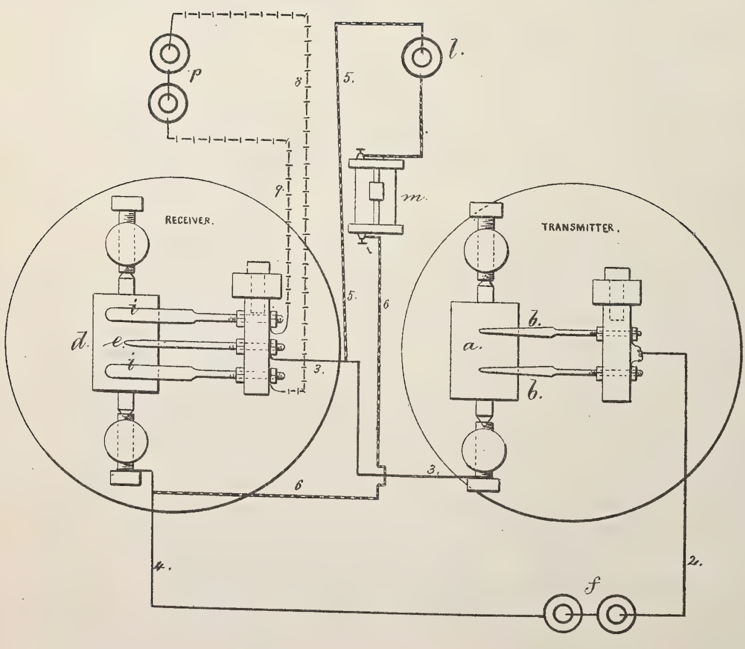
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Automatic Telegraph Instruments.

No. 134,867. Patented Jan. 14, 1873.



Witnesses,

Thos. H. Smith

Geo. D. Walker

Inventor

Thos. A. Edison

L. W. Serrell atty.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN AUTOMATIC TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. **134,867**, dated January 14, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphs; and the following is declared to be a correct description of the same.

In chemical telegraphs difficulty arises in preventing the earth currents marking the paper and interfering with the sharpness of the dot and dash marks.

In my present invention I neutralize the earth currents, and also prevent the stylus being destroyed by the action of the acid in the chemical paper while the circuit is broken on the main line or the instrument is not in action.

I employ a rheostat to regulate the action of a battery that supplies a very feeble constant current to neutralize earth currents, and a local constant current is brought into contact with the surface of the chemical paper to pass across the paper near the stylus and prevent, by polarizing such paper, the action of the acids upon the iron stylus or pen, thereby preventing injury to the same during the time that the instrument is not in use.

The diagram in annexed drawing illustrates this invention.

The transmitting-roller *a* is mounted and rotated in any usual manner, and *b b* represent the transmitting stylus, brush, or spring roller or rollers. The receiving-roller *d* is propelled in any convenient manner, and the paper is drawn along in the ordinary way. The stylus *e* or marker is of iron or other material to make a mark upon the chemical paper when the electric current passes through such paper. The spring-conductors *i i* are of platinum, and rest upon the chemical paper at each side of the stylus *e*. The main battery *f* is connected, through the wire 2, stylus *b*, roller *a*, line-wire 3, to the stylus *e*; thence by the wire 4 or earth connection, so as to mark the paper as usual. The battery *l* is connected to the rheostat *m*, and by the wire 5 to the line 3 and the wire 6 to the earth line 4, so that a very feeble current, adjustable by *m*, is thrown on the line and earth connections in the reverse direction to the earth currents, so as to neutralize the same. The battery *p* is connected by the wires 8 and 9 with the spring-conductors *i i* so that a current will pass across the chemical paper resting upon the roller *d*. The main-line current from the stylus gives to the particles an electric condition; that condition continuing tends to prolong the mark after the pulsation ceases; the cross or counter current neutralizes this electric condition or polarity, and prevents attenuation of the mark; it also prevents injury to the stylus or pen by the action of the acids in the paper, because the current passing between the conductors *i i* is superior to any ground currents and neutralizes their action.

I claim as my invention—

1. The circuit from the battery *l* connected with the earth and line in a chemical telegraph instrument and adjusted by the rheostat *m* to neutralize earth currents, substantially as set forth.

2. The conductors *i i* connected with the battery *p*, in combination with the stylus *e* of a chemical receiving instrument, for the purposes and substantially as set forth.

Signed by me this 8th day of May, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Electro-Magnetic Adjuster.

No. 134,868.

Patented Jan. 14, 1873.

Fig. 2.

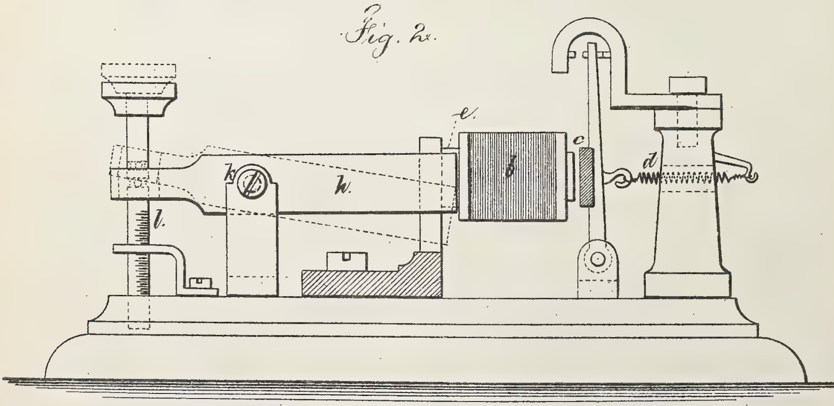


Fig. 3.

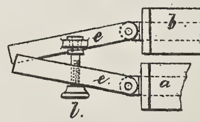
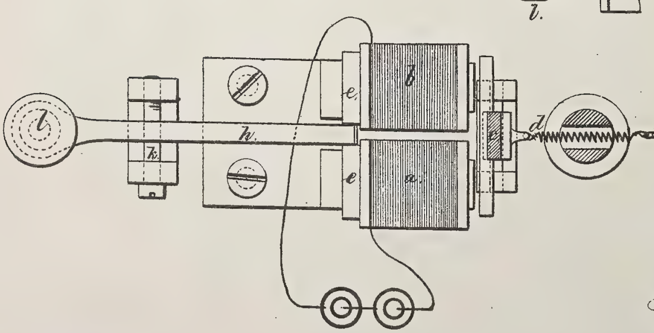


Fig. 1.



Witnesses,

Chas H. Smith

Geo. D. Walker.

Inventor

Thos. A. Edison

L. W. Serrell

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN ELECTRO-MAGNETIC ADJUSTERS.

Specification forming part of Letters Patent No. **134,868**, dated January 14, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Electro-Magnetic Adjuster; and the following is declared to be a correct description of the same.

This invention is available with an electro-magnet made of two helices and cores, and is intended to vary the power of the electro-magnets without changing the intensity of the electric current, and thus rendering it unnecessary to adjust the spring that draws back the armature, because the power of the magnet itself is adjusted so as to maintain uniformity in the same, and, consequently, preserve the proper relations between the force of the spring and the power of the magnet.

I make use of a variable connection between the rear ends of the cores, and thereby vary the magnetic power of those cores. If the two cores are entirely separated, so that induced magnetism is checked, there will be but little power in the core, even when the helix is properly charged; but when the cores are connected by a proper iron bar the entire force of the magnetism is developed. I make use of these known features of magnetism to vary the power of the electro-magnet by lessening the conductor that unites the cores at their rear ends.

In the drawing, Figure 1 is a plan of a magnet with my improvement, and Fig. 2 is a side view of the same, partially in section.

The electro-magnets *a b* are made of helices around cores in the usual manner, and the armature *c* is hung on centers to vibrate as usual, and may be employed as a relay, or in any other electrical apparatus. The spring *d* exerts a uniform retractile force, and does not require to be adjusted for varying its power. The iron bar *e*, at the back end of the magnet, is united to the cores as usual, but instead of being continuous it is divided, and the adjuster *h* applied between the parts. This adjuster is shown as a lever upon a fulcrum, *k*, and moved by a set-screw, *l*, so that the end of the lever makes a full contact between the ends of the bars *e*, as shown by full lines, or only a partial contact, as illustrated by dotted lines in Fig. 2; and hence the power of the electro-magnet will be varied according to the position of the adjuster. The same effect is produced in the modification illustrated in Fig. 3, the bars *e e* being hinged to the cores and adjusted more or less into contact with each other by the screw *l*.

I claim as my invention—

The adjustable connection applied at the rear end of an electro-magnet, between the cores thereof, to vary the power of such electro-magnet, substantially as set forth.

Signed by me this 8th day of May, A. D. 1872.

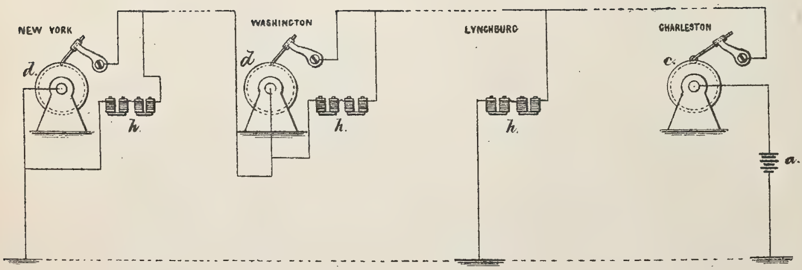
T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Circuits for Chemical Telegraphs.

No. 135,531. Patented Feb. 4, 1873.



Witnesses,

Geo. D. Walker.

Chas. H. Smith

Inventor

Thomas A. Edison,

Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CIRCUITS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **135,531**, dated February 4, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Circuits for Chemical Telegraphs, of which the following is a specification:

Before this invention telegraphic circuits had been arranged with a rheostat to regulate the portion of the electric pulsation passing to the chemical paper, and allowing the other portions of the pulsation to pass along upon the main line, or to go to the earth as a leakage. In these cases the rheostat did not produce any counter current, and served only to direct portions of the electrical waves through the chemical paper, but the tailing and the attenuation of the mark was not avoided, and upon long lines these marks usually ran together, because there was not sufficient time for the electric action to cease, or the line to free itself before another pulsation succeeded and the line became surcharged. In all cases it has been desired to obtain the most perfect insulation of the line to avoid the use of powerful batteries and to lessen atmospheric influences. It has, however, been found that when the insulation is impaired by atmospheric influences, the marks upon the chemical paper are more distinct, because the surplus electricity finds vent in currents to the earth, lessening the tailing.

When an electro-magnet is charged by a pulsation the electric action, in the circuit of which the helix of the magnet forms a part, is augmented; but when the main or line current is broken the magnet, in discharging itself of the magnetism that has been induced, sets up momentarily a counter current or one of opposite polarity. I avail myself of these various conditions, and arrange the circuits in such a manner that the electro-magnets which are energized by the pulsation that makes the mark on the chemical paper, serve to intensify the electric action upon that paper; but that the counter current, set up when the primary circuit is broken, shall neutralize the tailing or attenuation of the current by the discharge of the magnetism from the electro-magnet, thereby allowing for the use of very feeble currents and rendering the marks upon the chemical paper sharp and clear; and I furthermore employ upon long lines one or more earth connections, in which are placed one or more electro-magnets, with or without rheostats to regulate the proportion of currents passing to the earth, such connections and electro-magnets serving to free the line from surplus electricity and by the reverse polar action, as the electromagnet discharges itself, to free the line from any attenuation of the primary pulsations.

With long lines it is preferable to employ long electro-magnets; and the reverse, in order that the time occupied by the magnet in discharging its magnetism may be proportioned to the attenuation or tailing of the main current that is increased by the length of line.

In the diagram annexed I have illustrated my improvement by four stations, New York, Washington, Lynchburg, and Charleston. The message is being sent from Charleston to New York by the battery *a*, and any suitable transmitting instrument at *c*, such as a stylus and perforated paper, or a finger-key or other device. The battery may be connected with either the positive or the negative pole to the instrument, and the other to the earth wire. At New York is any suitable receiving instrument, at *d*, such as a drum and stylus, for the chemical paper. If intermediate connections are not required they may be dispensed with and the message will be received only at New York.

I provide a secondary or local circuit connected with the main circuit at both sides of the receiving instrument *d*, and in this I place the electro-magnets *h*. These and the others spoken of may be of ordinary character; but as quantity rather than intensity is required, large wires may be used for the helices, and solid bars, bundles, or tubes for the cores, and many of these may be employed, or a large number may be provided, and more or less may be brought into action by switches or a commutator. The helices might be of iron wire wound in several layers, and cores be dispensed with, the inner portions of the coils forming the electro-magnets.

When the circuit is closed and a pulsation passes in the main line, a local circuit will thereby be set up through the electro-magnets and connections in the same direction as that of the main-line, and thereby intensifying the

action upon the chemical paper, but as soon as the main-line circuit is broken the electro-magnets in discharging themselves set up a local circuit in the opposite direction through the stylus and chemical paper, neutralizing any tailing and causing the mark to be clear and distinct. The same effect is produced where the connections are arranged as at the station marked Washington, in order that a drop copy may be taken at that point.

At the station marked Lynchburg the electro-magnets *h* are placed in a branch or ground circuit, and the amount of the leakage regulated by the resistance of the magnets themselves, or of a rheostat, thereby conveying away, designedly, the proper portion of the current intermediately between the sending and the receiving station; and when the circuit of the main line is broken the electro-magnets set up a counter-current in the line as they discharge themselves, thereby freeing the line at one or more places, as circumstances require.

I claim as my invention—

One or more electro-magnets, arranged in a local or branch circuit, substantially as set forth, in combination with a chemical telegraphic receiving instrument, for the purposes set forth.

Signed by me this 9th day of November, 1872.

THOMAS A. EDISON.

Witnesses:
GEO. D. WALKER,
GEO. T. PINCKNEY.

T. A. EDISON.

Printing Telegraphs.

No. 138,869. Patented May 13, 1873.

Fig. 1. Fig. 3.

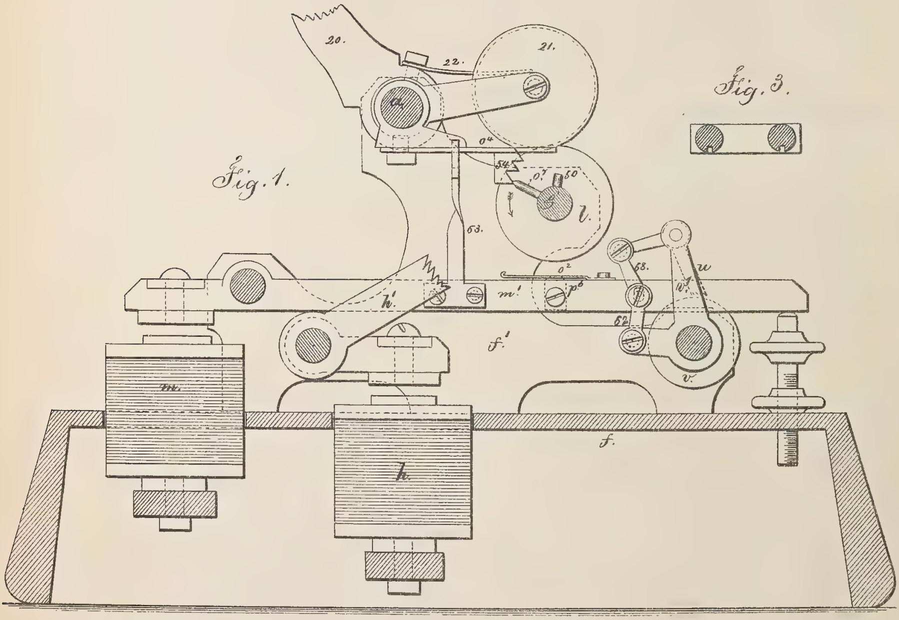
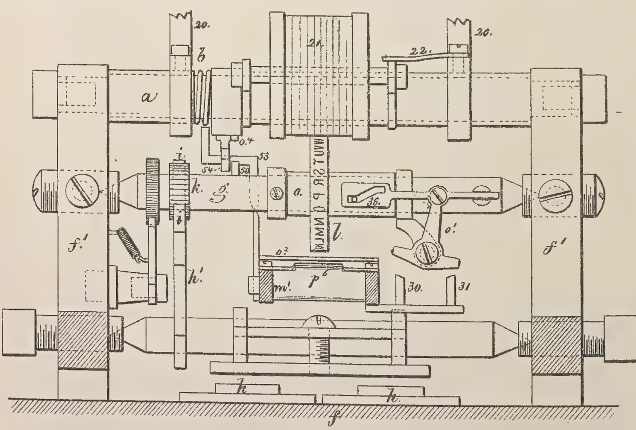


Fig. 2.



INVENTOR

Chas H. Smith

Harold Serrell

Witnesses.

Thos A. Edison

Per. Lemuel W. Serrell ATTY.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **138,869**, dated May 13, 1873; application filed October 22, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, of which the following is a specification:

This invention relates to modifications of and improvements upon the printing-telegraph machines heretofore patented by me. The features of improvement relate, first, to a unison mechanism that operates after two or more revolutions of the type-wheel, but is liberated and restored to a normal position each time the printing-lever is moved; second, to a peculiar paper-feeding mechanism that throws a tooth or pawl upon the paper, and then moves the same, and liberates the pawl from the paper before the return movement of the parts; third, to a means for partially rotating the type-wheel upon its axis to bring into position for use one set of characters, and throw out of use the alternate characters.

In the drawing, Figure 1 is a vertical section, and Fig. 2 is a partial front view, showing my present improvements.

The type-wheel magnet h acts through the armature and lever h' to set the type-wheel l, by a step-by-step movement given through the pallets i, escapement or ratchet wheel k, and shaft g. To insure greater rapidity in the discharge of the magnetism induced in the cores of the electro-magnet h, the said cores are grooved longitudinally, as shown in Fig. 3, which with a printing-telegraph is highly advantageous, because of greater rapidity, and avoiding the risk of inaccuracy arising from a sluggish backward motion in the armature. The inking-roller 21 is pressed toward the type-wheel l by the spring 22, upon the paper-reel arms 20, so that the sudden rotation of the type-wheel l will not swing said inking-roller away from contact with the types. This spring 22 can be turned aside when the inking-roller is to be lifted. Upon the shaft g is a tooth, o^7, that comes into contact successively with the teeth 54, and moves the arm o^4 down gradually until the end thereof is in the path of the stop 50, thereby arresting the type-wheel at a unison-point after the type-wheel has made two or more revolutions without the impression-lever m' being operated; but whenever the impression-lever is moved, the arm o^4 is raised by the finger 53 acting beneath it. In this manner the unison is prevented from coming into action except when the type-wheels are rotated with special reference to bringing a number into unison. The finger o^4 is sustained by a sleeve around the cross-bar a, and there is a spring, b, to apply the required friction to hold the parts in the position to which they are moved. The type-wheel l is upon a sleeve, o, surrounding the shaft g. The cam-bar 36 is sustained in guides upon the shaft g, and can be moved endwise by the T-lever o^1; and the shape of the cam 36 is such that it acts upon the sleeve o and type-wheel, to turn the same the extent of the distance from one character to the next; hence, where the step-by-step motion turns the type-wheel the distance occupied by two characters (for rapidity) the aforesaid cam 36 will bring into action one set of characters and throw out of action the other set of characters placed alternately around the type-wheel. The movement is given endwise to the cam 36 by the pin 30 or 31, upon the printing-lever coming into contact with the T-lever o^1, when the type-wheel is rotated around to the proper point for bringing such lever o^1 over the pin 30 or 31, after which the printing-lever is moved. The feeding-pawl u is upon an arm, v', and its lever is connected by a link, 68, to the printing-lever m', and the arm v', is connected also to m', but by a slotted link, so that as the lever m' rises, the strip of paper is first seized between the roughened end of u and the roller v; then the link 62 swings all the parts together. On the return movement the slot in 62 allows the pawl u to be lifted off the paper before the arm v' is swung back by the link 62.

I claim as my invention—

1. The tooth o^7 and stop 50 upon the shaft g, in combination with the arm o^4, teeth 54, and finger 53, moved by the printing-lever m', the parts being arranged and operated substantially as set forth.

2. The pawl u upon the arm v', and con-

nected by the link 68 with the lever m', in combination with the slotted link 62, that swings the lever v' to feed the paper, substantially as specified.

3. The cam 36 moved by the T-lever o^1 and pins 30 31 upon the printing-lever, in combination with the type-wheel l and sleeve o, substantially as and for the purposes set forth.

Signed by me this 16th day of October, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Printing Telegraphs.

No. 138,870.

Patented May 13, 1873.

Fig. 2.

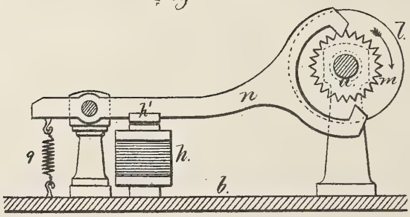
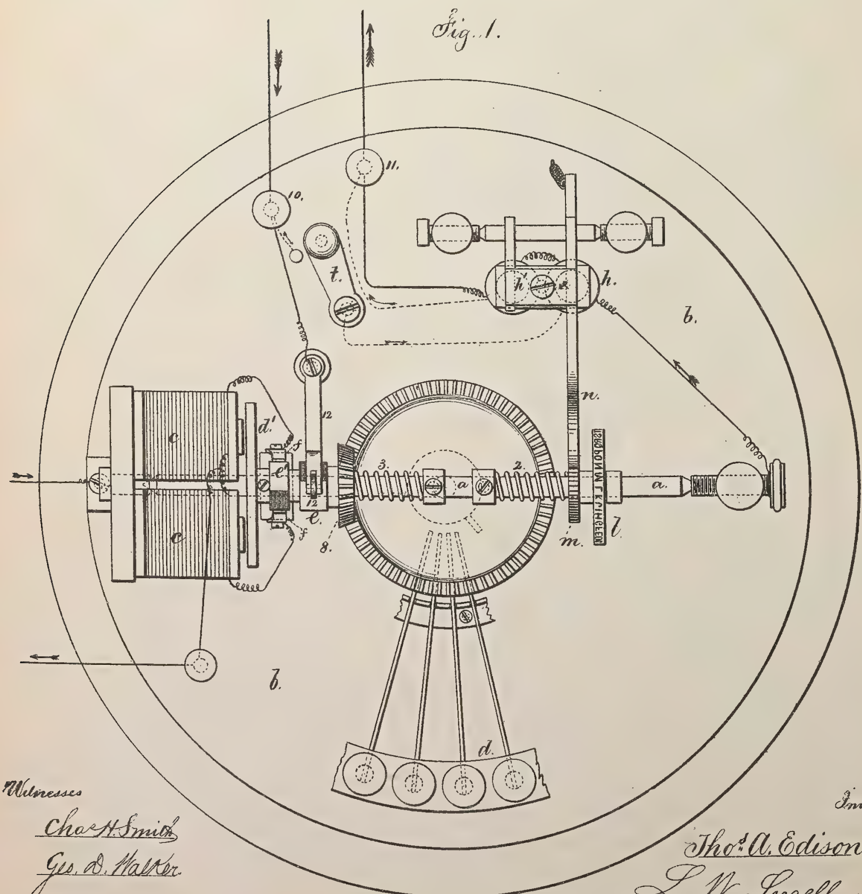


Fig. 1.



Witnesses

Chas H. Smith

Geo. D. Walker.

Inventor

Thos. A. Edison

L. W. Serrell Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH CO., OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **138,870**, dated May 13, 1873; application filed March 13, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraph Instruments, of which the following is a specification:

This instrument is a combined transmitter and receiver, and the pulsator (which opens and closes the circuit to the type-wheel magnets) and the type-wheel are upon the same shaft, and this shaft is revolved continuously by an electro-motor or other device.

The pulsator and type-wheel are both revolved by frictional contact with their shaft; but the type-wheel only moves with said shaft as the pallets of the type-wheel lever allow the escapement-wheel that is connected to the type-wheel to turn by a step-by-step movement. This lever is vibrated by its magnet and spring each time the pulsator opens and closes the circuit to said magnet; hence said type-wheel is moved by the step-by-step escapement each pulsation of electricity.

In the drawing, Figure 1 is a plan of my improved instrument, and Fig. 2 is an elevation of the type-wheel magnets, levers, and escapement.

The shaft *a* is supported in suitable supports or standards on the bed *b*, and is revolved continuously by the electro-motor, composed of the electro-magnets *c c*, revolving armature *d'*, circuit-breaker *e'*, contact-springs *f f*, and connections to a local battery, all of usual character; and it is to be understood that the shafts *a* of the distant receiving-instruments are each revolved by an electro-motor or other device, and about in unison with the shaft of the transmitter. *e* is the pulsator, and 12 its contact-roller for opening and closing the circuit to the type-wheel magnets *h*, and said pulsator revolves with the shaft *a* by friction of the spring 3.

The operation of this pulsator in opening and closing the circuit to said magnets *h* is the same as that set forth in Letters Patent No. 131,343 granted to me, and the means for stopping the pulsator and impressing from the type-wheel *l* are substantially the same as in said patent, the pulsator being arrested when a finger-key, *d*, is depressed and its arm brought in the path of a stop upon a shaft connected by gearing to a pinion, 8, that moves with the pulsator. The type-wheel *l* and its escapement-wheel *m* are upon a sleeve or otherwise connected, and they are upon said shaft *a* and move with it by friction through the spring 2 when permitted by the type-wheel lever *n*. The pulsations from *e* through the main line and magnets *h* at the distant stations vibrate the armatures *h'* and levers *n* in unison, letting off the teeth of the escapement-wheels and allowing the shafts *a* to revolve the type-wheels by a step-by-step motion.

The connections for the transmitter are shown by full lines in Fig. 1, the current entering by the binder 10 and passing through the pulsator *e*, shaft *a*, and magnets *h*, and by the binder 11 to the line and the distant receiving-instruments. Each instrument is provided with a switch at *t*, and the connections for the distant receiving-machines are shown by dotted lines in same figure.

The mechanism for impressing the letter and printing, when the type-wheels are stopped, may be of any desired character, and do not form part of this invention.

I claim as my invention—

The type-wheel and pulsator both upon the same shaft and revolved by friction, in combination with the type-wheel lever, escapement, and electro-magnet, substantially as and for the purposes set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

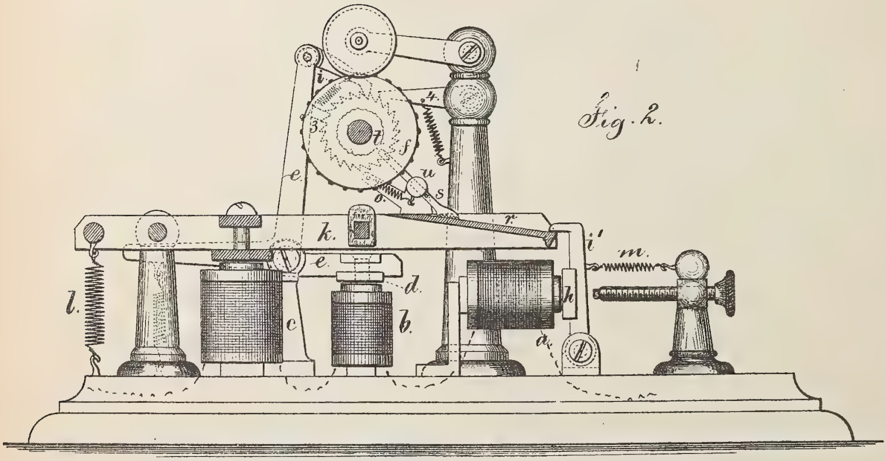
CHAS. H. SMITH.

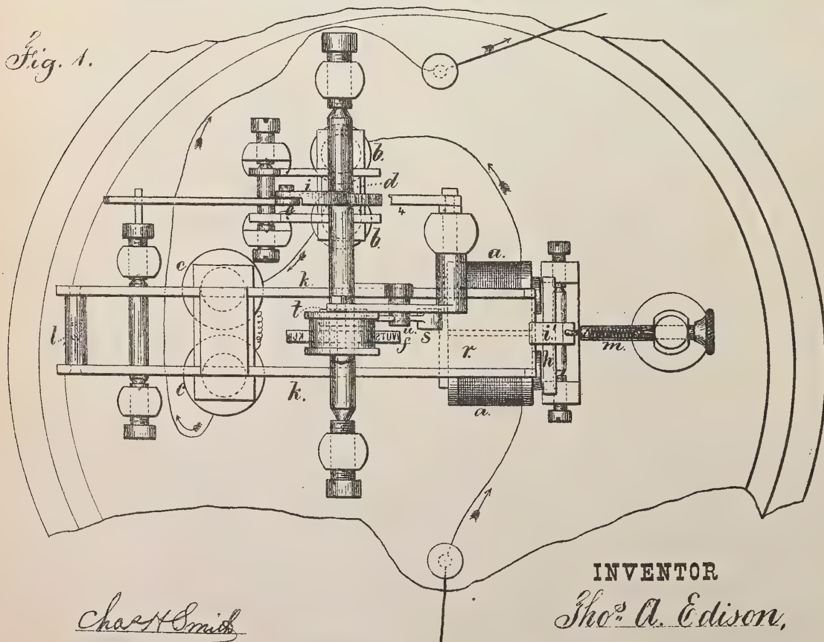
T. A. EDISON.

Printing Telegraphs.

No. 139,128.

Patented May 20, 1873.





Chas H Smith

Geo D Walker

Witnesses.

INVENTOR

Thos. A. Edison,

Per. Lemuel W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **139,128**, dated May 20, 1873; application filed February 18, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraph Instruments, of which the following is a specification:

In this instrument there are three electro-magnets, all in the main-line circuit, and they are so adjusted that the pulsations act in one of the magnets to set the type-wheel; but the other two magnets, discharging more slowly, act to hold down the printing-lever. When the circuit is broken and a pause ensues the electro-magets all discharge, allowing a spring to the armature of one to draw back a hook and allow the printing-lever to fly up by a spring. The next pulsation energizes all the magnets, drawing down the printing-lever and holding it; then the other pulsations set the type-wheel.

In the drawing, Figure 1 is a plan representing the improvement, and Fig. 2 is a side view of the instrument.

The magnets *a b c* are in the main-line circuit, as seen in Fig. 1, so that the pulsations energize all the magnets; the magnet *b*, however, is small, and so made as to rapidly discharge; hence the pulsations act to move the armature *d*, lever *e*, and pawl *i*, and set the type-wheel *f*. I remark that the dog 3, shown by dotted lines in Fig. 2, blocks the ratchet-wheel to prevent it turning too far by the inertia, and the pawl 4 prevents motion in the wrong direction. The magnet *a* acts upon the armature *h* and hook *i′* to hold down the printing-lever *k*, and the magnet *c* is sufficiently powerful to draw down that lever *k* against the action of the spring *l*.

When the circuit is broken and a pause ensues the magnets *a c* discharge themselves, and the spring *m* draws back the hook *i′*, allowing the spring *l* to throw up the printing-lever *k* and give the impression. When a pulsation is sent again the three magnets *a b c* are energized, the printing-lever is drawn down by *c* and latched by the hook *i′* until another pause on an open circuit occurs. The strip of paper passes between a sliding pawl, *s*, and a plate, *r*, upon the printing-lever, and this pawl *s* slides in a turning-stud, *u*, that is drawn back by a spring, *o*. Upon the shaft of the type-wheel *f* is a snail-wheel, *t*, shown by dotted lines in Fig. 2, the periphery of which is notched, of different distances from the center of the shaft, in accordance with the distance the paper is required to be fed for the letter impressed. As the printing-lever *k* rises, the end of the sliding pawl *s* comes into contact with this snail-wheel, and the other end, clamping the paper, slides it upon the incline or surface *r* until the printing is effected. At the reverse movement the spring *o* draws the sliding pawl back to the normal position.

I claim as my invention—

1. Three magnets in the main-line circuit, operating as set forth, in combination with the type-wheel lever, printing-lever *k*, spring *l*, and latch *i′*, substantially as and for the purposes set forth.

2. The sliding pawl *s*, in combination with the snail-wheel upon the type-wheel shaft, and the printing lever *k*, substantially as set forth, for feeding the paper.

3. A printing-lever and an electro-magnet arranged in connection with the type-wheel and its magnet, substantially as set forth, so that the printing-lever is drawn away from the type-wheel by the electro-magnet, and the printing is effected by breaking the circuit to the electro-magnet.

Signed by me this 21st day of January, A. D. 1873.

THOMAS A. EDISON.

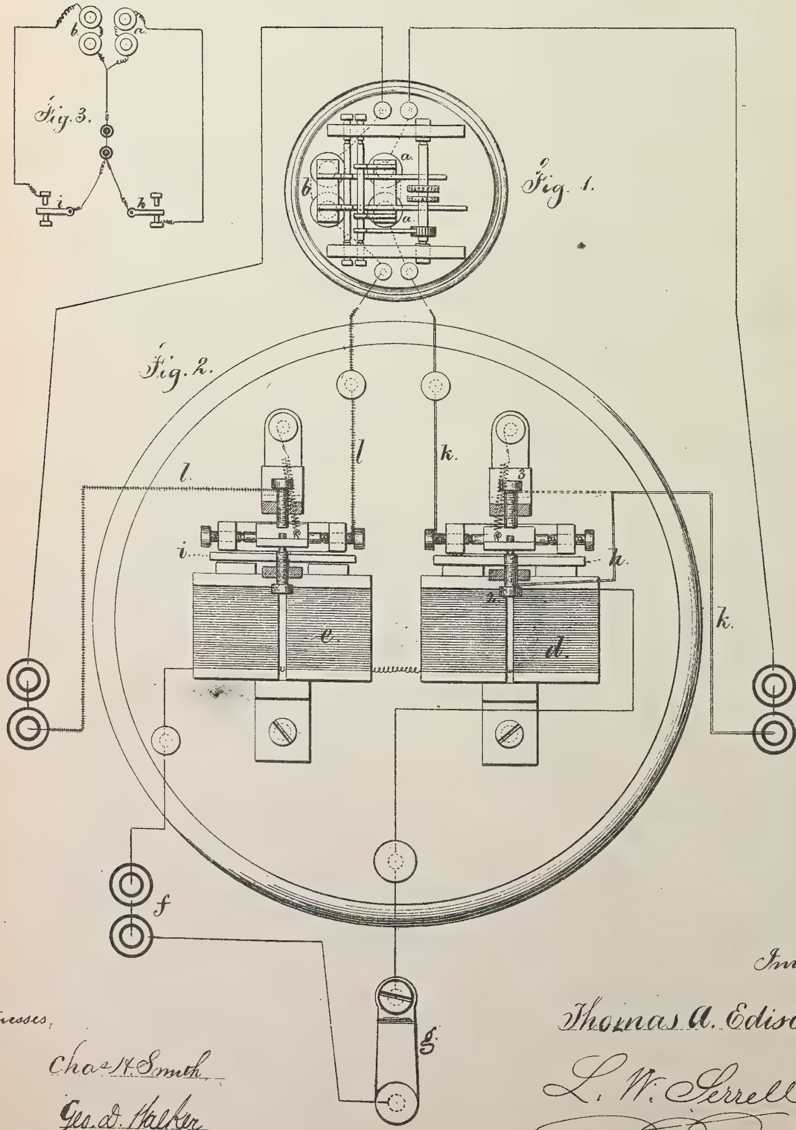
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Printing Telegraphs.

No. 139,129.

Patented May 20, 1873.



Witnesses,

Chas H. Smith

Geo. D. Walker

Inventor

Thomas A. Edison.

L. W. Serrell

atty.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **139,129**, dated May 20, 1873; application filed February 18, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Transmitting-Instruments for Printing-Telegraphs, of which the following is a specification:

In this instrument there are two electro-magnets in a main-line circuit, in which, also, is the key or other instrument for opening and closing the circuit. The relay-magnets are provided with armatures and circuit-closers, and the retractile springs of the armatures are of different tensions, so that the relay, working a local circuit through the type-wheel magnet of the printing-instrument, energizes the same each pulsation in the main line. The local circuit of the printing-magnet remains broken, because the armature of that relay-magnet is kept toward the magnet by the residual magnetism until a pause in the transmission occurs sufficient to allow the printing relay-armature to recede and close the relay circuit to the printing-magnets. In this manner it is only necessary to pulsate the main-line circuit and pause to effect the printing when the type-wheel has been set.

In the drawing, Figure 1 shows a printing-telegraph instrument of any desired character, *a* representing the type-wheel magnet, and *b* the printing-magnet. Fig. 2 is a plan of the relay-instrument.

The magnets *d* and *e* are in the main-line circuit from the battery *f*, and *g* is a finger-key or other closer at the distant station to pulsate the current through *d e*. The armatures *h* and *i* are drawn back by springs of different tension, the spring of *h* being the most powerful, so that the armature *h* will respond to each pulsation of *g*, and close and open the local circuit *k* to the type-wheel magnet *a* in the various printing-instruments; thereby the type-wheels will be set by such pulsations. During these pulsations the armature *i* will be held toward the electro-magnet *e*, because of the residual magnetism and slight tension of the retractile spring of the armature; but when a pause occurs the magnet *e* discharges itself, the armature *i* is drawn away, and the relay circuit *l* closed to the printing-magnets *b*, so as to give the impression. If the printing is to be effected when the local circuit *k* is closed, the connection will be made to the screw 3 instead of the screw 2. With circuits arranged as in the diagram, Fig. 3, only one local battery will be required, the connections and operations corresponding with those before described. The magnet *d* may be used for setting the type-wheel by direct action of the armature on pallets, and the armature of the magnet *e* be used to close the local circuit to the printing-magnet *b*, as before.

I claim as my invention—

1. Two relay-magnets in the main circuit, with retractile springs to the armatures of different tensions, in combination with relay circuits to the type-wheel and printing electro-magnets, respectively, of a printing-telegraph instrument, substantially as and for the purposes set forth.

2. Two relay-magnets in the main circuit, with armatures adjusted differently, in combination with a local circuit effecting distinct and different operations, according to the length of pause between pulsations in the main line, substantially as specified.

Signed this 13th day of February, A.D. 1873.

THOMAS A. EDISON.

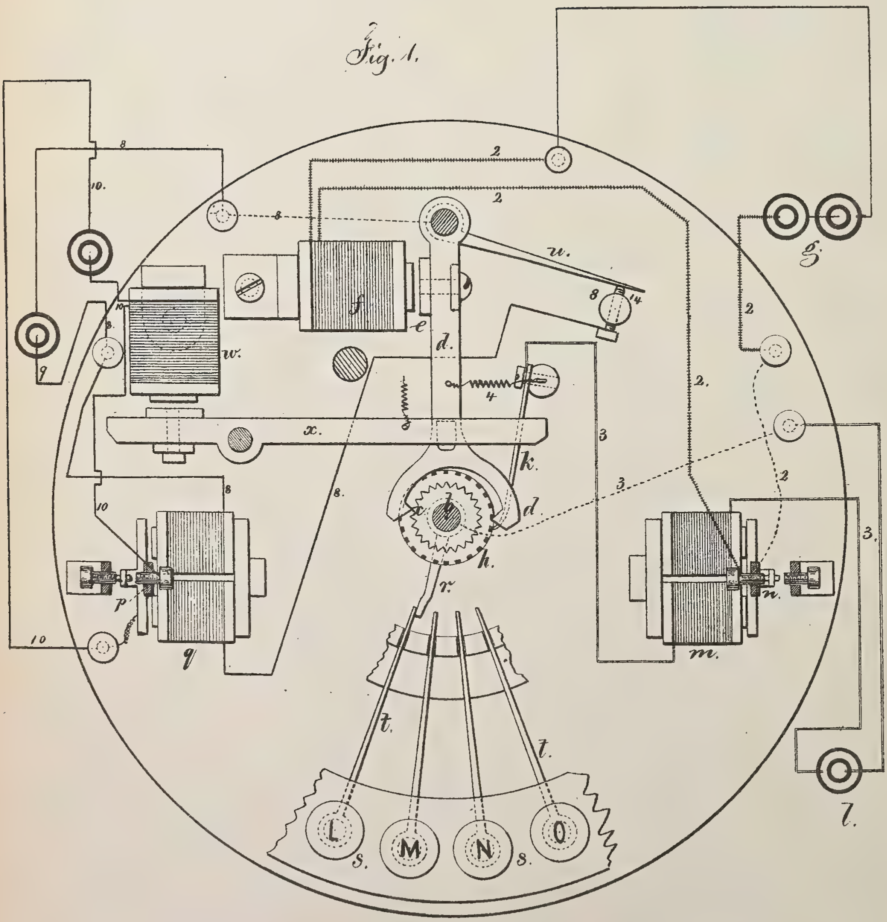
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets--Sheet 1.

T. A. EDISON.
Printing Telegraphs.

No. 140,487. Patented July 1, 1873.



INVENTOR
Thomas A. Edison
Per. L. W. Serrell
ATTY.

Chas H. Smith
Geo D. Walker
Witnesses.

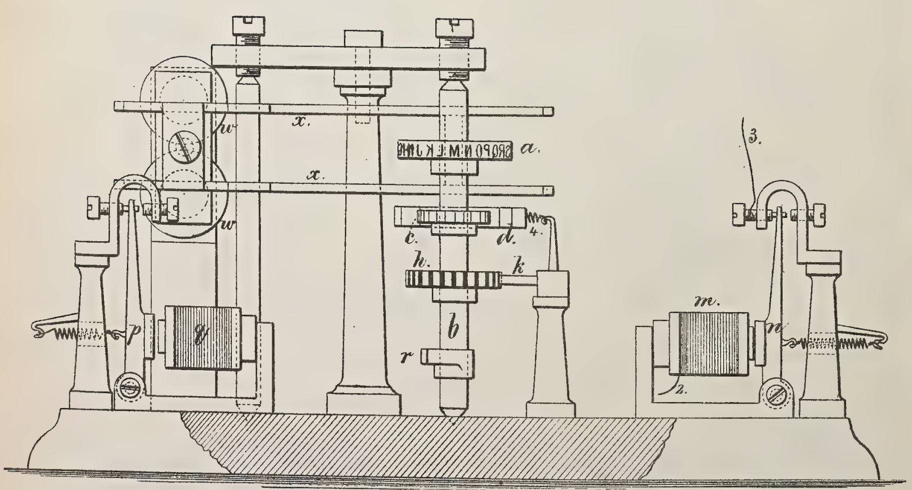
2 Sheets--Sheet 2

T. A. EDISON.

Printing Telegraphs.

No. 140,487. Patented July 1, 1873.

Fig. 2.



INVENTOR

Thomas A. Edison,

Per L. W. Serrell

ATTY.

Chas H Smith

Geo. D. Walker

Witnesses.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **140,487**, dated July 1, 1873; application filed February 18, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented Improvements in Printing-Telegraphs, of which the following is a specification:

In this improvement the transmission is effected by pulsations through a break-wheel, relay-magnet, and main line; and as the pulsation energizes the relay-magnet it closes a local circuit to a type-wheel magnet that acts upon pallets to rotate the type-wheel and the break-wheel, and in so doing breaks the main-line circuit, and allows the main line to break the local, and the spring of the type-wheel armature to draw the latter back, and by the pallets move the type-wheel and break-wheel around further, and reclose the main circuit, and repeat the operations before described. These connections are resorted to to prevent too rapid movement. The main-line pulsations act in all the instruments of the line to set the type-wheels through the local circuits. The transmitting-instrument is stopped at a point when both circuits are broken, and in each receiving-instrument the pallet-lever, being drawn back by a spring, closes a local circuit to a magnet that operates the printing-circuit and energizes the printing-magnet.

In the drawing, Figure 1 is a plan representing portions of the instrument and the circuit-connections, and Fig. 2 is a side view of part of the instrument.

The type-wheel *a* is upon a shaft, *b*, that has a pallet-wheel, *c*, operated by a pallet-lever, *d*, the armature *e* of which is moved by the magnet *f*, that is in the circuit 2 2, from the battery *g*. A break-wheel, *h*, upon the shaft *b*, and a contact-spring, *k*, of suitable construction, are in the circuit 3 from the battery *l*, in which circuit is the relay-magnet *m*, the lever *n* of which opens and closes the circuit 2.

The operation of these parts is, that when *m* is energized the lever *n* closes the circuit 2; this energizes the type-wheel magnets *f*, and by the pallet-lever *d* the type-wheel is moved half a space. This at the transmitting-instrument breaks the circuit 3 by one of the non-conducting segments of the wheel *h* coming under the end of *k*. The circuit 3 being broken, the lever *n* falls back, breaking the circuit 2, and the magnets *m f*, discharging, allow the spring 4 to draw back the pallet-lever *d*, moving the break-wheel *h* far enough to close the circuit 3 again, and the operations are repeated, thus producing an automatic opening and closing of the circuits 2 and 3, and the speed of movement can be regulated by the tension of the armature-springs.

If the circuit 3 is the main line, then the circuit 2 will be local at the transmitting and receiving stations; but if the circuit 3 is local the circuit 2 may be the main line, and the circuit 3 will not be in use while receiving.

If a finger-key is depressed the arm *r* upon the shaft *b* is arrested by the lever *t* of the finger-key *s*, (a few only of these keys are shown, but they are of usual character,) and the parts are in the position shown; but both circuits 2 and 3 are broken, and the spring *u* closes the circuit 8 from the battery 9 to the local magnet *q*, the armature-lever *p* of which closes the printing-circuit 10, that passes through the printing-lever magnets *w*, so that a pause at the transmitting-instrument allows time for the energizing of the respective magnets *w* and the printing of the letter by the levers *x*.

The printing may be effected with one local circuit, if the spring *u* forms part of the circuit 10; and in cases where these instruments are used with two line-wires the line-wire forms part of the circuit 10 to the printing-magnet of the distant instrument or instruments. As the finger-key is raised the spring 4 draws the pallet-lever *d*, and turns the wheel *h* sufficiently to close the circuit 3, and the pulsations are set up as before. The time that the spring *u* is in contact with the circuit-screw 14 is momentary, except when there is a pause by depressing one of the keys; hence the printing-magnets will only be energized at that time.

I claim as my invention—

1. The combination of the type-wheel, pallet-wheel, circuit-wheel *h*, and pallets with the circuits 2 and 3 and electro-magnets *m* and *f*,

substantially as set forth, for automatically opening and closing the respective circuits and rotating the type-wheels, as set forth.

2. The printing-circuit closed by the spring *u* of the pallet-lever when the circuits 2 and 3 are broken, and the movement of the type-wheel arrested by the depression of a finger-key, in combination with the pallets that are moved by the spring and close the type-wheel circuit when the finger-key is released, substantially as set forth.

Signed by me this 13th day of February, A. D. 1873.

THOMAS A. EDISON.

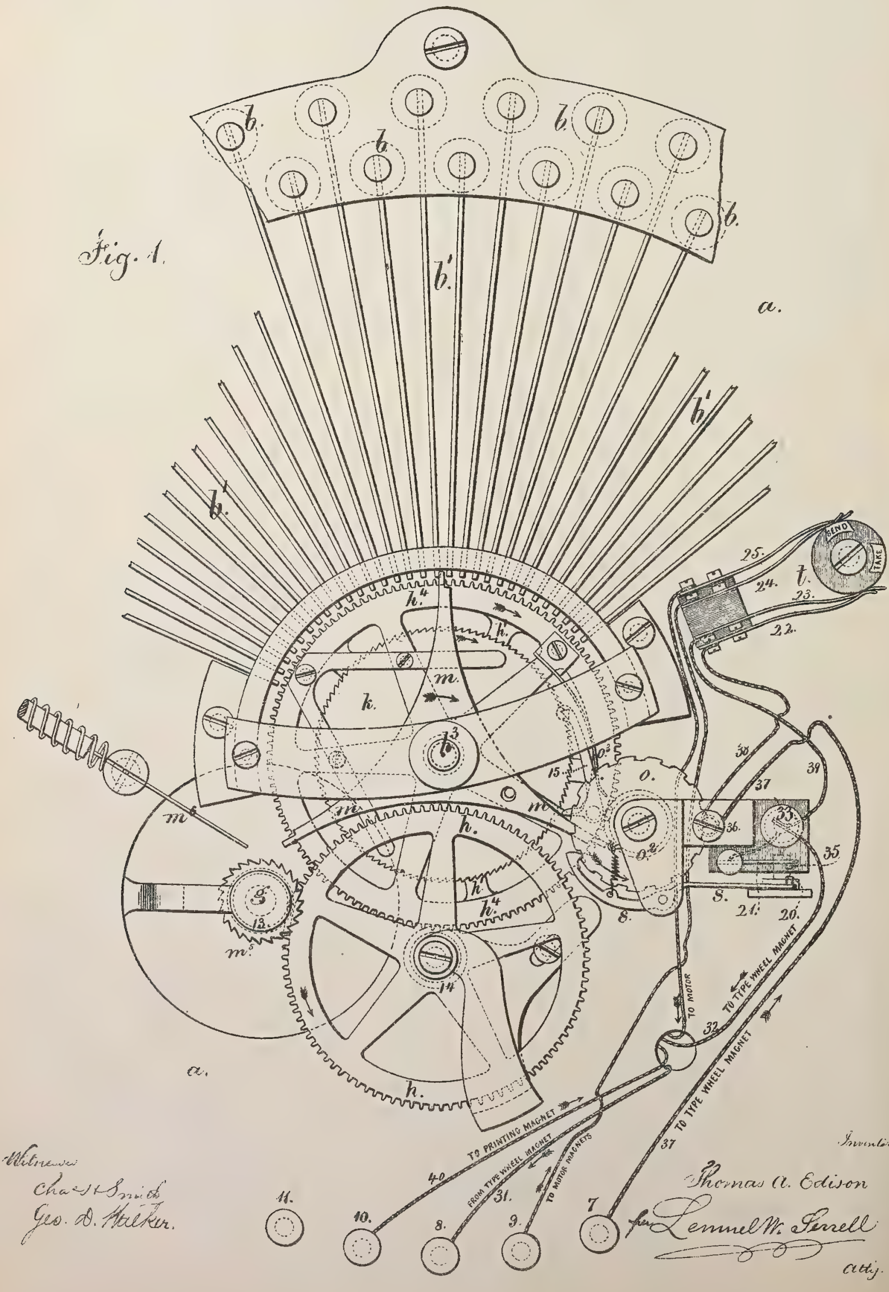
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

3 Sheets--Sheet 1.

T. A. EDISON.
Printing Telegraphs.

No. 140,488. Patented July 1, 1873.

Fig. 1.



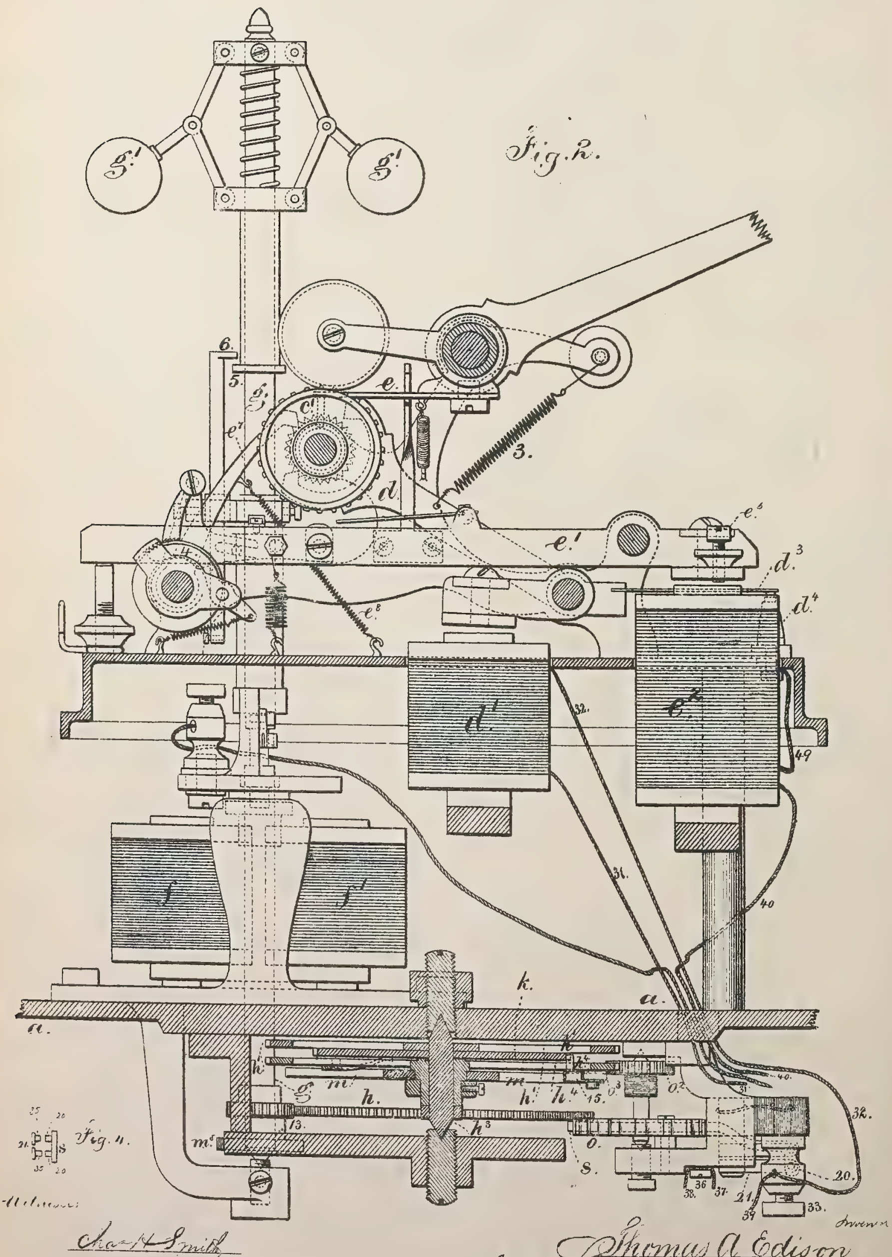
Witnesses
Chas H Smith
Geo. D. Walker

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty.

T. A. EDISON.
Printing Telegraphs.

No. 140,488.

Patented July 1, 1873.



Witnesses:

Chas H Smith

Geo. T. Walker

Inventor

Thomas A. Edison

per Lemuel W. Serrell

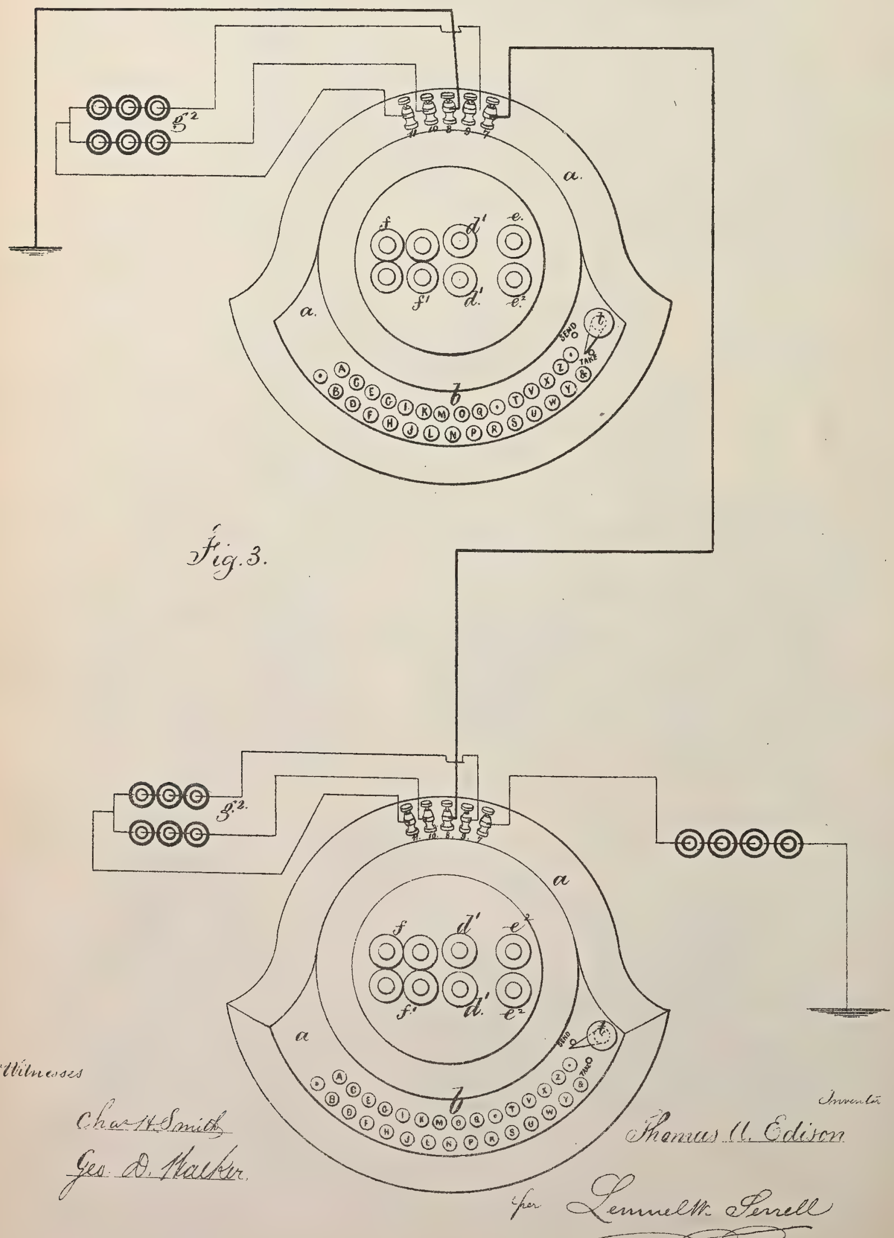
atty.

3 Sheets--Sheet 3.

T. A. EDISON.
Printing Telegraphs.

No. 140,488.

Patented July 1, 1873.



Witnesses

Chas H. Smith

Geo. D. Walker.

Inventor

Thomas A. Edison

per Lemuel W. Serrell

AM PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **140,488**, dated July 1, 1873; application filed May 16, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, of which the following is a specification:

In this machine there is a circuit-breaker driven by an electric engine, and this pulsator makes and breaks the circuit of the main line and causes all the type-wheels in the circuit to revolve in unison through the agency of an electro-magnet and step-by-step mechanism. When a key at the transmitting-station is depressed it stops the circuit-breaker and arrests the movement of the type-wheels. At each station is a local battery that is brought into action by the cessation in the movement of the type-wheel lever closing the circuit and throwing the current into the printing-magnet.

In the drawing, Figure 1 is an inverted plan, representing the principal portions of the mechanism. Fig. 2 is a vertical section, showing the operative portions of the machine; and Fig. 3 is a general plan view on a smaller scale, representing the connections.

The bed a of the machine is of suitable size and shape, and around on one side is a range of finger-keys, b, occupying one-third of the circle, and these are connected with the bars b', beneath the bed a, that stand radially around the wheel h^4 that is in the middle of the bed, and is hereafter referred to. The type-wheel c' is revolved by a step-by-step movement from the lever d, electro-magnet d^1, and spring 3. The unison mechanism e and the printing-lever e^1 and magnet e^2 are similar to those in my patent No. 126,532. The feeding mechanism for the paper is similar to that in my patent No. 126,532, and there is a pawl and retaining-clamp, 4, to prevent the paper drawing back, as in said patent. The motor consists of the electro-magnets $f\,f'$, vertical shaft g, and governor-balls g^1, and the speed is regulated by short-circuiting the battery-connection by the collar 5 and finger 6, as in my patent No. 131,343. The connections are made as shown in Fig. 3; the binding-screws 7 and 8 are the line-connections, or line and earth. The connection 9 is to the engine, and 10 to the printing-magnet, and 11 is the return-connection to the local battery g^2. The motor drives the wheel h by the pinion 13, and this communicates motion to the pinion 14 and a wheel, h^1, to which is attached a ratchet-wheel, k. The wheel h^4 is loose upon the same shaft as the wheels h^1 and k, and it is rotated by a pawl, 15, that is upon the wheel h^4, and takes the teeth of the ratchet-wheel k. The arms m, three in number, project from a hub around the shaft h^3. One of them is contiguous to a knuckle on the pawl 15, so that when one of the finger-keys b is depressed, and one of the arms m comes into contact with the bar b' of the depressed key, then the arms m are arrested, and the wheel h^4, moving slightly by the pawl, brings the knuckle of the pawl into contact with said arm m, and throws the pawl out from the ratchet-wheel k, thereby allowing the ratchet-wheel k and wheel h^1 to continue to revolve, but stopping the wheel h^4 and the parts deriving motion from it. In this manner the circuit-closing wheel o is stopped, said wheel receiving motion from the pinion o^2, and as soon as the finger-key is raised the spring o^3 throws the pawl 15 back into contact with the ratchet-wheel k, and the motion of the circuit-closing wheel is renewed. The lever s is operated by cam-projections on the wheel o, and, by the contact-points 20 and 35, and springs 21, the circuit next described is opened and closed. There is an insulated block, t, upon which the springs 22, 23, 24, and 25 rest, and in it are conducting-blocks. When a knob above the bed of the machine is turned to the word "take," the circuit is closed through the springs 22 and 23. When it is turned to the word "send," the circuit is closed through 24 and 25. The parts are so timed that the number of times the circuit is opened and closed during each revolution of the wheel h^4 equals three times the number of the keys b, and hence that the pulsations acting in the line make three revolutions of the type-wheel, the pulsations passing by the binder 7, wire 37, screw 36, metallic frame and lever s, contact-points 20 35, springs 21, and connection to the binder 33, wire 32, magnet d^1, wire 31, and binder 8, and thence along the line to the distant instruments, and setting their type-wheels,

and when the revolution of h^4 is stopped by depressing a key, the letter of the type-wheels corresponding to that on the depressed key is in position for printing. At the receiving instrument the block t is turned to take, and the circuit-closer is no longer included in the circuit, but the pulsations go direct through the magnet d^1 to set the type-wheel, the route being by binder 7, wire 37, binder 36, wire 38, spring-arms 22 and 23, wire 39, binder 33, wire 32, magnet d^1, wire 31, and binder 8 to line or earth connection. While the type-wheel lever d is vibrating the spring d^3 thereon does not remain in contact long enough with the anvil d^4 to energize the printing-magnet e^2; but so soon as the pulsation in the type-wheel magnet ceases the circuit is closed through d^3 and d^4, the current passing by binder 10, wire 40, magnet e^2, wire 49, anvil d^4, spring d^3, lever e^1, frame and bed a, and binder 11 back to battery g^2, and the printing effected. The fulcrum of the printing-lever e^1 is to be loose in its bearings, so that the momentum may carry the lever and its pad up to the type and produce the impression, and then fall away to prevent blurring the letter when the type-wheel is again revolved. The brass screws e^6 passing through the armature of the lever e^1, coming into contact with the cores of e^2, prevent adhesion between the surfaces and adjust the blow of the impression-pad. A ratchet-wheel, m^5, upon the governor-shaft g is provided, and a spring-pusher, m^6, is used to start the governor and motor in the right direction when the machine is put into motion. The contact-points 20 and spring contact-points 35 are in pairs, as seen in the detached view, Fig. 4, and two of the points touch before the other two, the object being to lessen the risk of false or defective pulsations, because the intensity of the spark between the contact-points produces oxidation that sometimes prevents the transmission of the pulsation. This spark is between the points that first come into contact; but if the spark fails between these it passes between the second pair of contact-points, and because this second pair is so seldom exposed to the action of the spark, their surfaces remain free from oxidation a very long time.

Stop-pawls have been used to prevent the type-wheel turning back, but they have been employed in connection with spring-pawls or on a separate ratchet-wheel. I employ the pawl e^7 and spring e^8 in connection with the wedge-acting pallets shown, and such pawl is so constructed that it prevents the type-wheel being turned the wrong way by holding the type-wheel in place when the pawls are not in contact with the ratchet-wheel, but are moving from one side to the other.

I claim as my invention—

1. The circuit-breaking wheel o actuated by the wheel h^4, in combination with the pawl 15, ratchet-wheel k, arms m, and range of finger-key bars b', substantially as and for the purposes set forth.

2. The switch-block t, circuit-springs 22 23 24 25 and their connections, substantially as set forth, in combination with the circuit-closer o, line-connections and type-wheel magnets d^1, substantially as set forth.

3. The starting mechanism, consisting of the pawl m^6 and ratchet-wheel m^5, in combination with the governor and magnetic motor, substantially as set forth.

4. The screws e^6 applied to the armature of the printing-magnet, for the purposes set forth.

5. The stop-pawl e^7, in combination with the type-wheel, wedge-acting pallets, and ratchet-wheel, for the purposes set forth.

6. The double pairs of spring circuit-closing points 20 and 35, one pair set to come into contact before the other pair, for the purposes set forth.

Signed by me this 23d day of April, A. D. 1873.

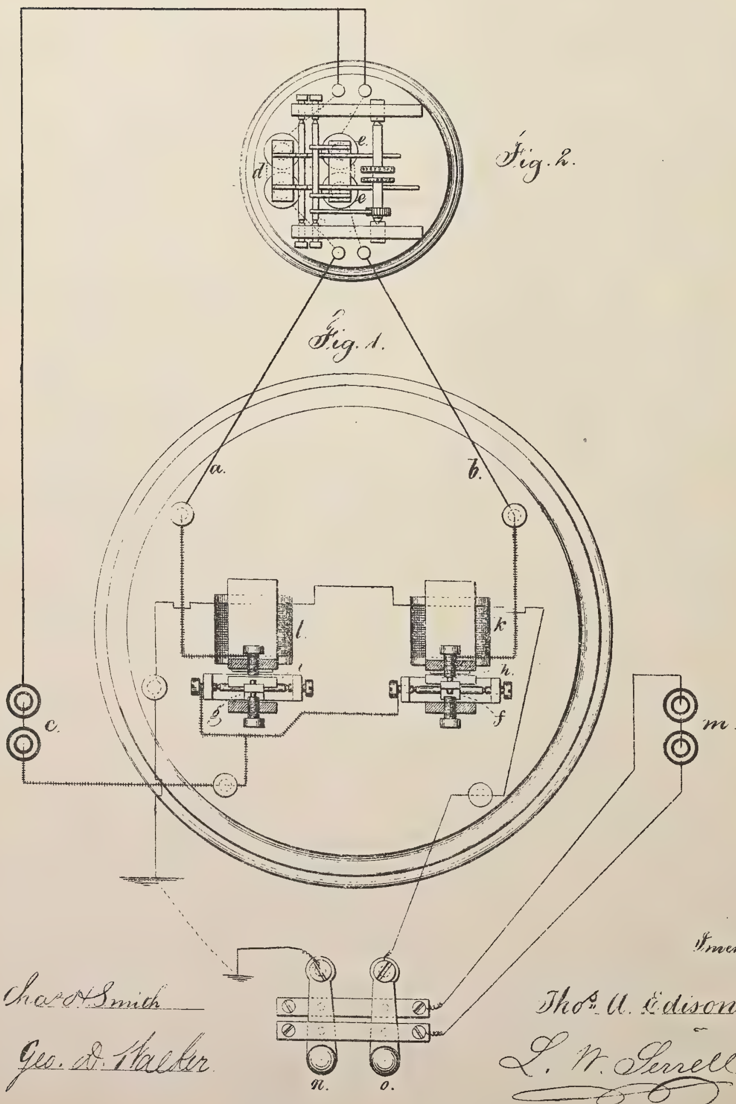
THOS. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

Circuits for Printing Telegraphs.

No. 140,489. Patented July 1, 1873.



Witnesses

Chas H. Smith

Geo. D. Walker

Inventor

Thos. A. Edison,

L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN CIRCUITS FOR PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **140,489**, dated July 1, 1873; application filed February 18, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Circuits for Printing-Telegraph Instruments, of which the following is a specification:

In this instrument two relay-magnets are in a main-line circuit and their cores or armatures are polarized. The electro-magnets are so made that a pulsation of one polarity will attract one armature and repel the other, and the reverse when a current of opposite polarity is sent. The armatures of these electro-magnets open and close the circuits of a local battery, in which is placed the type-wheel and printing-magnets of a printing-telegraph instrument. When pulsations of one polarity act in the relay-magnets the type-wheel magnet of the printing-telegraph will be operated, and when a reverse polarity is sent through the relay-magnet the printing-circuit will be operated.

In the drawing, Figure 1 is a plan of the relay-magnets, and Fig. 2 represents the printing instrument and the circuits in which it is connected.

I remark that the printing instrument is to be of any desired character adapted to use with two circuit-connections, *a b*, such circuits passing, respectively, through the printing-magnet *d* and type-wheel magnet *e*. *c* represents the battery for the circuits *a b*, and this is connected with the circuit-closing levers *f* and *g*, upon which are the polarized armatures *h i* of the relay-magnets *k l*. These magnets *k l* are in the main circuit from the battery *m*, and when the key *n* at the distant station is depressed the pulsation passing through the magnets *k l* will be of negative polarity, and when *o* is depressed will be of positive polarity.

The electro-magnets *k l* are so made that when the key or pulsator *o* is operated, the magnet *k* will be operative upon its armature *h* to close and open the circuit *b* to the type-wheel magnet *e* and the armature *i* will be repelled; but when the type-wheel has been set the key *n* is to be depressed and the polarity reversed to act upon the armature *i*, and close the circuit *a* through the printing-magnets *d*, repelling the armature *h*.

By this transmitting mechanism the circuits *a b* can be operated at the distant station or stations with reliability and facility over a single line main circuit.

I remark that a pulsator-wheel and index-hand corresponding with the type-wheel may take the place of the keys *n o*.

The polarization of the electro-magnets may be effected by permanent magnetism in the core or armature, or in any convenient manner.

I claim as my invention—

Two polarized electro-magnets in a main circuit, in combination with two local circuit-connections to the magnets of a printing instrument, and a mechanism for opening and closing the main circuit and reversing the polarity of the current, substantially as and for the purposes set forth.

Signed by me this 13th day of February, A. D. 1873.

THOMAS A. EDISON.

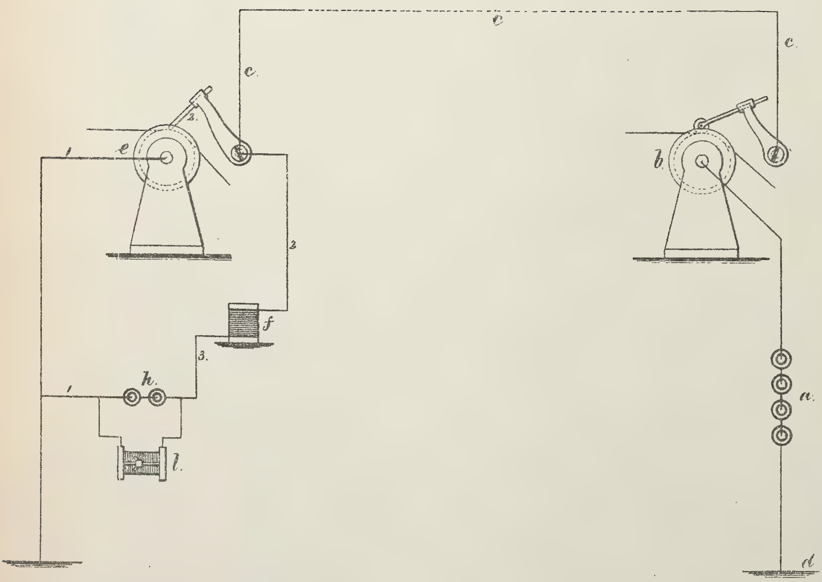
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Circuits for Automatic or Chemical Telegraphs.

No. 141,772. Patented August 12, 1873.



Witnesses,

Chas. H. Smith

Geo. D. Walker

Inventor

Thomas A. Edison

Lemuel W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN CIRCUITS FOR AUTOMATIC OR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **141,772**, dated August 12, 1873; application filed November 9, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Circuits, of which the following is a specification:

In chemical telegraphs it often happens that the pulsations of electricity that reach the paper are too powerful; and hence there is an elongation or attenuation of the mark upon the paper, causing the characters to be indistinct or to run into each other.

The present invention is to prevent this difficulty by regulating the quantity of the current passing to the chemical paper, and then bringing in an adjustable reverse current to neutralize any tailings.

In the annexed diagram the peculiarity of arrangement of circuits and instruments is illustrated.

A battery, *a*, is connected through the transmitting instrument *b* to the line-wire *c*, and the earth connection *d* is of the usual character. At the receiving-station the instrument *e* is to be of ordinary character for presenting the chemical paper to the action of the stylus and current. Rheostats have been used between the main-line and receiving instrument, and also in a shunt or branch circuit connected with the earth, and a battery has been placed in the shunt or branch circuit. I employ a rheostat, *f*, in a shunt connection between the parts of the main line, through which a portion of the electric pulsation passes, the rheostat being sufficient to counteract the resistance of the chemical paper, and cause the proper proportion of current to pass through said paper. The battery *h* is placed in the main or branch line with its poles in a position to cause the electricity to circulate through the local circuit composed of 1, *e*, 2, *f*, and 3, in a direction opposite to that in the main line, so that any attenuation of the mark may be prevented by the reverse action of the currents. If the before-mentioned parts only were employed, the local battery *h* might be sufficient to neutralize the electric pulsations in the main line. I therefore introduce a rheostat, *l*, between the poles of the battery *h*, and the same should be variable or adjustable to allow the action of the battery *h* to be varied, and only so much of the reverse current directed through the local circuit and the chemical paper as will prevent the attenuation or tailing of the mark upon the chemical paper, leaving that mark clear and distinct.

I claim as my invention—

The rheostat *l* applied to the battery *h* in the local circuit to regulate the action thereof, in combination with the rheostat *f* in the branch circuit, and the receiving instrument in the main circuit, substantially as and for the purposes set forth.

Signed by me this 5th day of November, A. D. 1872.

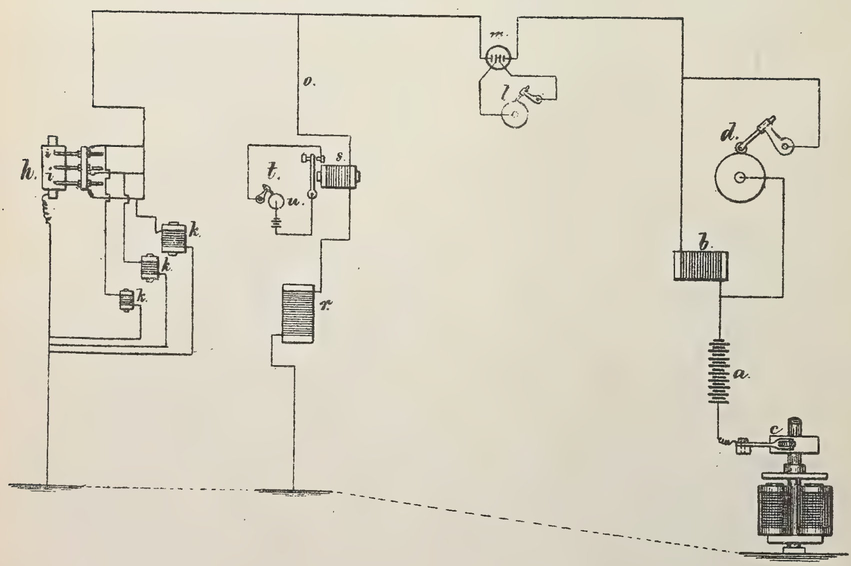
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Circuits for Automatic Telegraphs.

No. 141,773. Patented August 12, 1873.



Witnesses,

Chas H Smith

Geo. T. Pinckney

Inventor

Thos A. Edison.

Lemuel W. Serrell

atty

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CIRCUITS FOR AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **141,773**, dated August 12, 1873; application filed January 15, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented Improvements in Circuits for Chemical Telegraphs, of which the following is a specification:

This invention is intended for rendering the reception of the message more reliable and free from blurring or tailings upon the chemical paper. The line is kept statically charged by a battery, the circuit of which is interrupted with immense rapidity by an electromagnetic engine or other device. At the receiving end there is a shunt with an electromagnet in it. The electric tension is adjusted by a rheostat at the transmitting-station, so that ordinarily there will not be any mark at the receiving-station in consequence of the electro-magnet and shunt; but when the tension in the line is increased by the current going through the perforations of the paper at the transmitter and directly to the line, so as to cut out the rheostat, then a mark is made at the receiving-instrument, but there will not be any attenuation of the pulsation to produce tailings.

At the receiving-station I employ two or more styluses or pens, all connected with the main line, and to each is a shunt-circuit and an electro-magnet. The magnets are of varying character or power; hence they will act differently upon the stylus, and one will be sure to make a legible mark, although the electric conditions may vary from time to time or during the reception of the message, and the operator will be able to read the message reliably upon one of the two or more corresponding lines of marks on the strip before him.

In the diagram I have illustrated my improvement.

The battery *a*, rheostat *b*, and rapid contact-breaker *c* are in the main line or circuit. The rheostat, which may be adjustable, only allows the immensely rapid pulsations from *c* to pass sufficiently upon the line to keep the same statically charged to the required extent. The transmitting-instrument *d* is in a shunt that connects with the line on both sides of the rheostat; hence the pulsations through the paper reach the line direct and increase the electric tension sufficiently to operate the receiving-instrument. The receiving-instrument *h* may be of any suitable character; but I find that there should be either an electro-magnet in a shunt-circuit to neutralize the static electricity by the counter-current as the magnet discharges, or else a battery and rheostat with the polarity of the shunt or local circuit the reverse of that of the main line. I, however, prefer to use two or more styluses or pens, *i i*, connected to the main line and to shunt-circuits, in which are placed the electro-magnets *k k*.

The tailings from the pulsations are neutralized by the reverse currents set up in the shunt-circuits as the electro-magnets discharge themselves; and by employing magnets of different powers or qualities there will be greater certainty of the record being clear and legible in one of the two or more lines of marks upon the strip of chemical paper, because the coils of the magnets are of different resisting power to vary the currents passing to the paper; and the secondary current induced in the magnet is more or less active as it is discharged.

Where a drop copy is desired it may be obtained upon the line by placing the two ends of the wires in a glass of water, *m*, and also the two poles of a local circuit, in which is a chemical-receiving instrument, *l*. By adjusting the proximity of the ends of the main-line wires to those of the local circuit the necessary division will be made for producing the record without materially interfering with the main line. At intermediate stations a branch connection, *o*, may be made to the earth with a resistance-coil, *r*, therein, and one or more of these coils may be brought into action by a switch, and these coils may form parts of electro-magnets, or a separate electro-magnet, *s*, be introduced, and a drop copy may be taken in a shunt-circuit, *t*, in this branch earth-circuit, by the electro-magnet acting upon a circuit-closing lever.

The magnet *s* may be made to operate a relay or sounder or a receiving-instrument at the local station, indicated at *u*.

I am aware that liquid rheostats or resistances have been made use of; but I am not aware that the ends of the line and of a shunt-circuit have been introduced in a liquid, and the four ends so varied or adjusted in position as to proportion the shunt and main-line currents.

I claim as my invention—

1. The resistance *b* and transmitting-instrument *d*, arranged in connection with the line, the battery *a*, and the rapid circuit-breaker *c*, as and for the purposes set forth.

2. Two or more styluses or pens connected with the main line and with shunt-circuits, in which are differing magnets for operation upon the chemical-receiving paper, as set forth.

3. The vessel of liquid receiving the two ends of the shunt-circuit and the two ends of the main line to vary the strength of the shunt-circuit according to the relative positions of such circuit ends, as set forth.

Signed by me this 12th day of December, A. D. 1872.

THOMAS A. EDISON.

Witnesses:

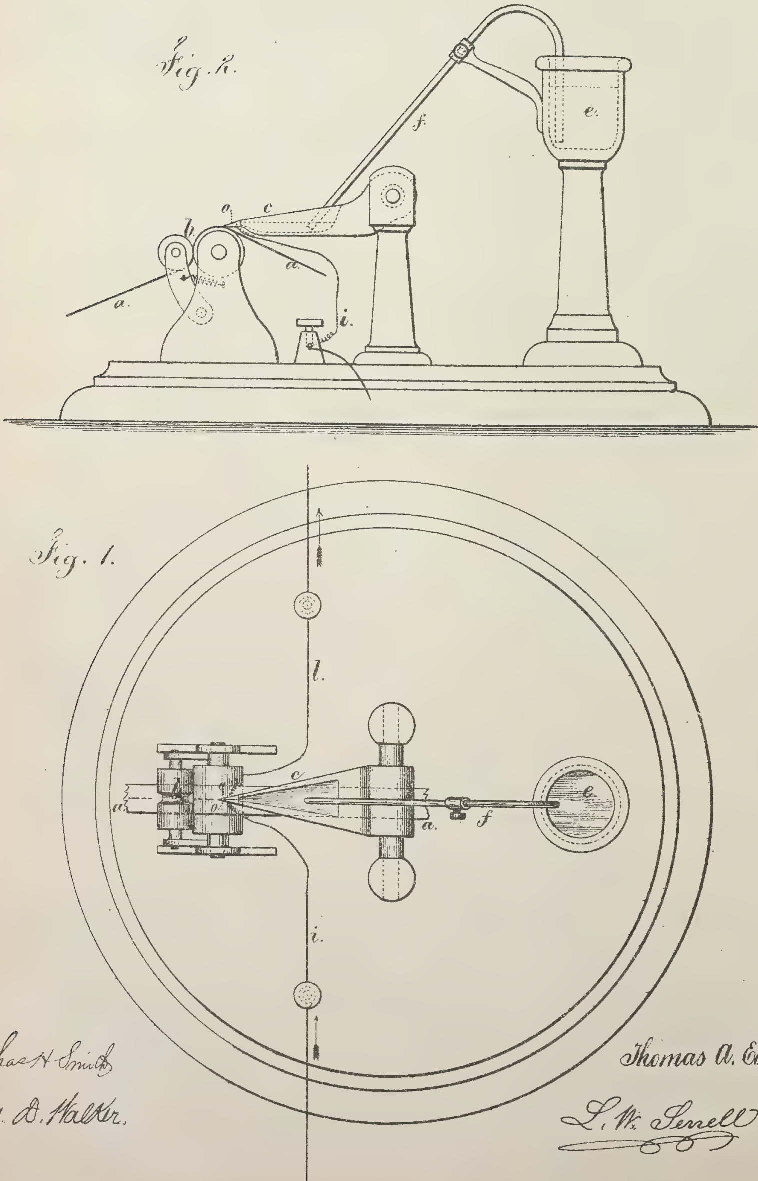
GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Chemical Telegraphs.

No. 141,774. Patented August 12, 1873.



Witnesses,

Chas H. Smith

Geo. D. Walker.

Inventor

Thomas A. Edison.

L. W. Serrell

atty.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **141,774**, dated August 12, 1873; application filed March 13, 1873.

To all whom it may concern:

Be it known that I, Thomas A. Edison, of Newark, in the county of Essex and State of New Jersey, have invented Improvement in Chemical Telegraphs, of which the following is a specification:

My invention relates to a chemical telegraph in which the paper is moistened as it runs through the machine, and receives the mark from the electric action upon the chemical ingredients employed. I make use of a trough or pen similar to a paper-ruling pen, and I supply to the same the chemical solution by a siphon, or otherwise, so that the strip of paper is moistened in a line immediately before or at the time that the mark is made, and the electrodes or contact-points are applied to the surface, either contiguous to the place where the liquid solution issues upon the paper, or more or less remote from the same. Thereby the decomposition of the liquid will be effected just as the same issues from the pen upon the paper, or after the solution has reached the paper and before it becomes entirely dry.

In the drawing, Figure 1 is a plan of the instrument, and Fig. 2 is a side view of the same.

The strip of paper *a* is drawn along by the rollers *b* in any of the known modes employed in automatic telegraphy. The solution is applied to the surface of the same by a ruling-pen, such as used by draftsmen, or in paper-ruling machines.

I have shown the pen *c* as a trough-shape, tapering down to the end that rests upon the paper, and into this trough the chemical solution is either placed or supplied from a fountain or reservoir, *e*, by a siphon, *f*, or otherwise.

The wires *i l*, that are in the telegraphic circuit, and through which the electric pulsations pass, are connected to two points or electrodes, *o o*, that are sufficiently close together to act upon the moist solution and decompose the same and leave the mark upon the paper, and these are placed where they will act upon the solution itself just as it issues from the pen upon the paper, or else upon such solution in the paper while it remains in a moist condition, thus insuring the proper mark and employing but a small quantity of solution.

I am aware that the strip of paper has been moistened in a narrow line by a roller immersed in the chemical solution, so as to apply the same to the paper before coming into position to receive the mark; but the paper offers a great resistance to the current, not being moistened entirely through by the time it reaches the stylus. By employing circuit-points at the surface at opposite sides of the moistened line this is avoided.

I claim as my invention—

The circuit-points or electrodes *o o*, connected with the wires *i l* and applied at each side of the line of chemical solution upon the surface of the paper, substantially as set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

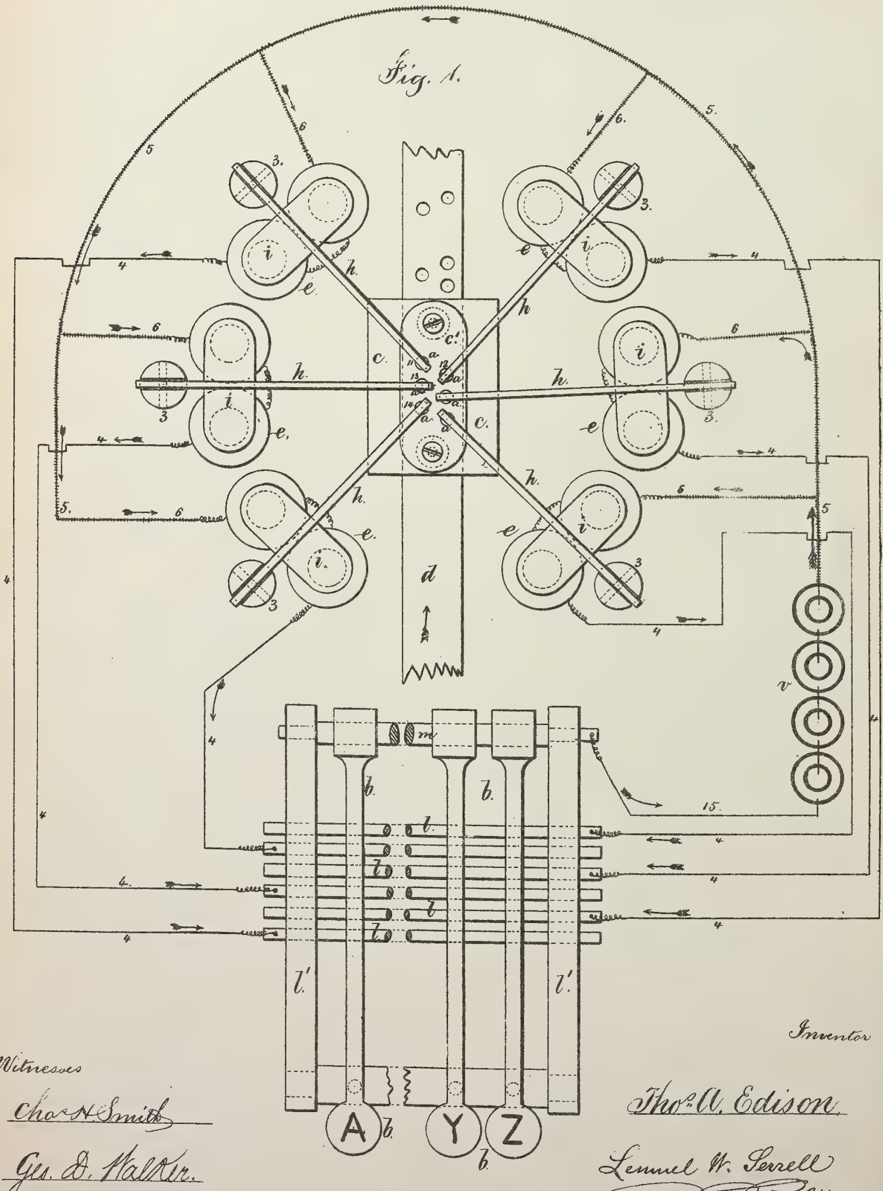
Witnesses:
Geo. T. Pinckney,
Chas. H. Smith.

2 Sheets--Sheet 1.

T. A. EDISON.

Perforators for Automatic Telegraphs.

No. 141,775. Patented August 12, 1873.



Witnesses

Chas. H. Smith

Geo. D. Walker.

Inventor

Thos. A. Edison.

Lemuel W. Serrell Atty

2 Sheets--Sheet 2.

T. A. EDISON.

Perforators for Automatic Telegraphs.

No. 141,775. Patented August 12, 1873.

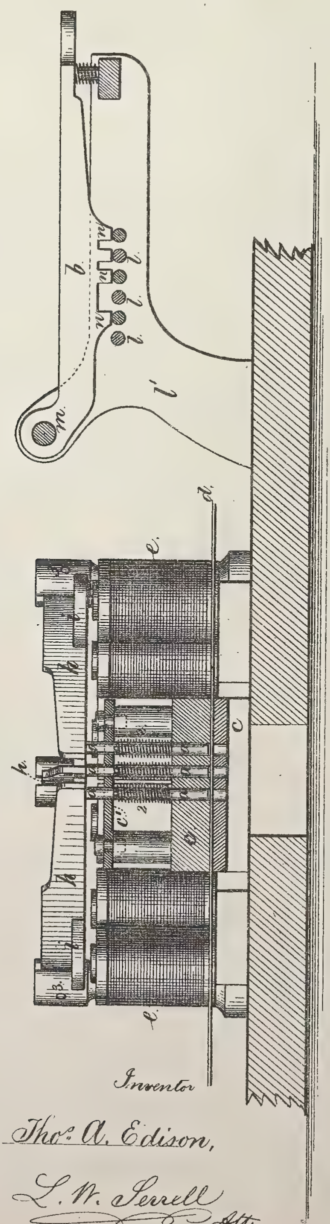


Fig. 2.

Inventor

Witnesses

Chas H. Smith

Geo. D. Walker

Thos. A. Edison,

L. W. Serrell Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN PERFORATORS FOR AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **141,775**, dated August 12, 1873; application filed March 13, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Machines for Perforating Paper for Use in Automatic Telegraphy, of which the following is a specification:

In Letters Patent No. 121,061, granted to me, a device is shown for perforating paper in which the punches are moved by power applied to finger-keys acting through cams and slide-bars.

My present invention relates to employing electro-magnetism as the motor to project the punches, so as to render the work of operating the machine less fatiguing to the hand and arm of the operator than if the power to move said punches is applied by the hand to the keys; and by this improvement I dispense altogether with the cams and slide-bars of aforesaid patent.

I employ an electro magnet or magnets to actuate each punch through an armature and lever, and the connections to the magnets are arranged so that by depressing a finger-key the circuit is closed to the proper magnet or magnets, and they, by their levers, move the punch or punches, and the paper is perforated with the character corresponding to that of the depressed finger-key.

In the drawing, Figure 1 is a plan, and Fig. 2 is a vertical section, of my improved machine.

a a represent the punches (and of these there should be ten) for making the characters composing the Morse alphabet. I have shown but six to avoid duplication of parts, and for the same reason only three keys of the horizontal range of finger-keys *b b* are represented. The punches *a a* are placed in two rows, and move vertically in the die *c* and guide-plate *c'*, and are kept raised from off the strip of paper *d* by the springs 2 2 when not acted upon by the levers *h h* of the electro-magnets *e e*.

The paper is drawn through an opening in the die *c*, beneath the punches, by any suitable feeding device; but, as this forms no part of my invention, it is not represented in the drawing.

The electro-magnets *e e* for actuating the punches are supported upon the bed of the machine, and are preferably arranged in a circle, with their levers *h h* radiating from the group of punches, as shown in Fig. 1, so as to economize space and allow of said levers acting upon their respective punches without risk of interfering with each other. Each lever is provided with an armature, *i*, and moves upon a fulcrum, 3; and said lever may either rest upon its punch *a* or be connected to it by a pin and slot. Beneath the range of finger-keys *b b* there is a range of metallic bars or rods, *l l*, supported and insulated in the frames *l' l'*; and there is the same number of bars *l* as there are punches *a*. Each bar *l* is in metallic connection with its magnet *e* by the wire 4, and the battery *v* is connected to all the magnets *e* by the wire 5 and branches 6 6. The finger-keys *b b* are pivoted upon the rod or shaft *m*; and upon the under side of each key there are one or more projections, *n*, each contiguous to a bar, *l*; and these projections are different in number and position upon the various keys, and arranged so that when a key is depressed and its projections in contact with the bars *l* the circuit is closed to such magnets *e* as actuate those punches that produce a character corresponding with that of the depressed key. Thus the key shown depressed in Fig. 2 is provided with four projections, *n*, and the circuit is closed to the four magnets that actuate the punches marked 11, 12, 13, and 14, and the character made is three perforations in one line and one in the other line, the whole representing a long dash and dot.

When a key, *b*, is depressed the current from the battery *v* passes to the magnet or magnets *e e* by the wire 5 and branch or branches 6 6, and from said magnets, by the wire or wires 4, to the bar or bars *l*, finger-key *b*, shaft *m*, and wire 15, back to the battery.

By this arrangement of mechanism the punches are operated by the power of electro-magnets, and the finger-key only performs

the duty of closing the circuits through said magnets.

The arrangement of the electro-magnets may be varied, and they may be more or less direct acting upon the punches, and positioned according to the arrangement and number of the punches.

I claim as my invention—

A group of punches for perforating telegraphic paper, actuated by a separate electro-magnet to each punch, in combination with the circuit-bars *l* and a range of finger-keys, for selecting the circuits that are to be closed to perforate the paper in accordance with the character upon the key, substantially as set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

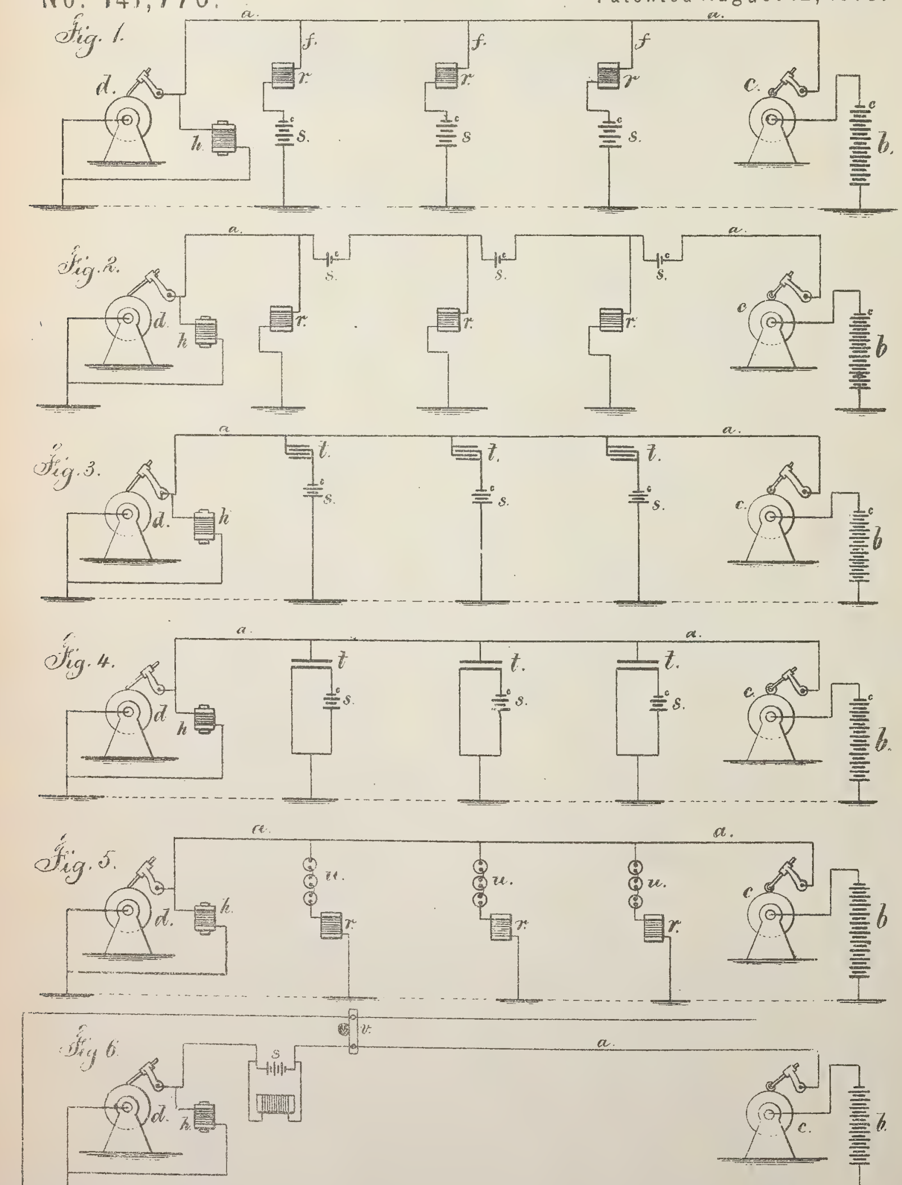
GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Circuits for Automatic Telegraphs.

No. 141,776. Patented August 12, 1873.



Witnesses.

Chas. H. Smith

Geo. T. Pinckney

Inventor

Thomas A. Edison

Lemuel W. Serrell atty.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN CIRCUITS FOR AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **141,776**, dated August 12, 1873; application filed January 15, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Circuits, of which the following is a specification:

In automatic telegraphing the speed of the pulsations is such that the line becomes surcharged, and the mark upon the chemical paper is attenuated to such an extent that one mark runs into another, or dots appear like dashes. The chemical paper is now made very sensitive, and a very feeble current is sufficient for making the mark; but in long lines the difficulty in clearing the line of the static electricity has been so great as to reduce the speed of transmission in order to obtain legible characters.

My present invention has been devised and successfully employed for effecting the clearing of the line without injury to the transmission of the pulsations.

Leaks and ground-connections have before been employed. My invention, therefore, does not relate thereto.

I make use of a battery, or a number of batteries, at a distant station, or distributed along the line, such battery or batteries being much weaker than the sending-battery, and connected in such a manner to the main line as to direct upon the same a current of opposite polarity, which has to be overcome by the pulsations from the sending-station; but these are always sufficient, and the slight reverse current, acting in detail upon the line-wires, keeps them free from any attenuation in the transmitting pulsations, thereby increasing the rapidity of automatic telegraphing, especially on long lines, and rendering the writing clear and sharp.

In the diagrams on the drawing, *a* represents the line; *b*, the transmitting-battery; *c*, the transmitting-instrument; and *d*, the receiving-instrument. In the former a strip of perforated paper and stylus are employed; in the latter a strip of chemical paper and a stylus.

In Figure 1 there are several branch circuits, *f*, in which are placed rheostats or resistances *r*, that may be adjustable, and also batteries *s*, that are of the proper power, and placed with the opposite pole to the line to that of the battery *b*, so that the line is operated upon in detail, at suitable distances apart—say every one hundred miles, more or less—and the line freed from tailing; and the same is opposed to the main current, but not sufficiently powerful to neutralize the same or to interfere with the transmission. These batteries *s* are so proportioned or adjusted as to be equal to the static electricity or current generated by the passage of the main current. The rheostats or resistances *r* are sufficient to prevent the battery *b* being short-circuited through the various branch-circuit connections to the earth, and to cause the proper proportion of said battery-current to reach the receiving-instrument.

In Fig. 2 the same parts are employed; but the opposition batteries *s* are placed in the main line, and distributed along the same. The branch circuits to the earth, with resistances, act with the local opposition batteries to establish currents counter to the main current.

In Fig. 3 the effect produced is the same as before described; but in place of rheostats there are condensers *t*, and the opposition local batteries *s*, acting upon the condensers, establish an opposite polarity on the plates of the condenser that are connected with the line to the polarity of such plates when influenced by the transmitting-battery, thereby neutralizing the tailings by charging the line statically in opposition to that from the main current.

The condensers may be connected with the opposition local batteries, in the manner seen in Fig. 4, so that the plates that are connected to the line-wire will also be connected to one pole of the battery, and the other plates of the condenser will be connected with the earth and the other pole of the battery, the operation being similar to that before set forth.

In Fig. 5 the parts are the same in their operation as those before described; but instead of ordinary batteries, cups *u*, containing platina or carbon strips and acidulated water, are employed, so that when the pulsation on the main line ceases to charge such cups a momentary reverse current is established to neu-

tralize the tailing by instantly freeing the line of any electric charge.

In Fig. 6 the line-battery *s* is introduced at the receiving-station, to neutralize any local current that may leak from one insulator to another upon the poles *v*, and tend to charge the line sufficiently to produce a light continuous mark upon the paper, the battery *s* not being sufficient to interfere with the pulsations for the message, although its poles are opposed to the same.

The electro-magnets, at *h*, are in a shunt, connected at both sides of the receiving-instrument, to neutralize any tailings at the instrument, as in my application No. 61, dated November 9, 1872.

I claim as my invention—

The use of an opposition or secondary battery of weak power at one or more points, to act in the main line in opposition to the pulsations from the transmitting-instrument, to free the main line of surplus or static electricity, substantially as set forth.

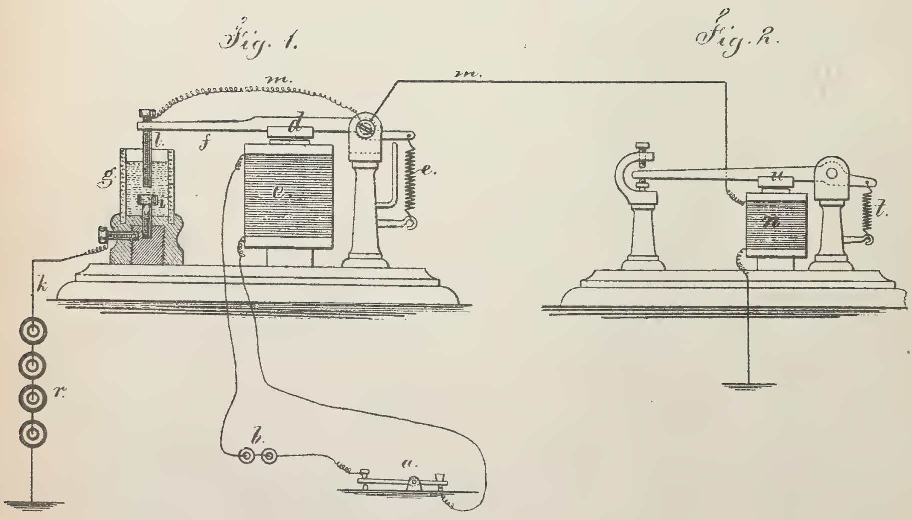
Signed by me this 12th day of December, 1872.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Relay Magnets.

No. 141,777. Patented August 12, 1873.



Witnesses,
Chas H Smith
Geo. D. Walker

Inventor
Thomas A. Edison
Lemuel W. Serrell
atty.

AM PHOTO-LITHOGRAPHIC CO N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN RELAY-MAGNETS.

Specification forming part of Letters Patent No. **141,777**, dated August 12, 1873; application filed March 13, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Instruments, of which the following is a specification:

Relay-magnets are employed to a large extent in various telegraphic operations. It is, however, found that the adjustment of the springs that draw back the armature and the burning of the contact-points by the spark are sources of constant annoyance.

My present invention is made for preventing the points burning out, and for avoiding adjustment of the retractile armature-springs.

I make use of metallic contact-points within a liquid, such as glycerine or water, so that the motion of one contact-point nearer to or farther from the other raises and lowers the electric tension in the telegraph-line, and operates a distant magnet without forming a spark or breaking the circuit.

In the drawing, Figure 1 is a side view of the relay-magnet with the circuit-cup in section, and Fig. 2 is a side view of the distant magnet.

The finger-key *a* is in a circuit from the battery *b;* so also are the coils of the relay-magnet *c*. The armature *d* and its lever *f* are moved by the spring *e* in one direction, and by the magnet *c* in the other. The circuit-cup *g* is made to contain water, glycerine, or other suitable liquid. In the bottom is the screw or point *i*, connected with the circuit-wire *k*, and the movable point or screw *l* passing through the lever *f* is connected with the other circuit-wire *m*, extending to the distant magnet *n*. The battery *r* is in the circuit to the magnet *n;* and it will now be understood that by adjusting the point *l* nearer to or farther from *i* the proportion of current passing to the magnet *n* can be adjusted so that, when the point *l* is moved by the magnet *c* nearest to *i*, the current from *r* will be sufficiently powerful to energize the magnet *n* and draw down its armature *u;* but when the circuit to the magnet *c* is broken at the key *a*, or otherwise, the movement of the point *l* away from *i* will lessen the tension in the circuit *k m* by the resistance of the intervening liquid, and weaken the power of the electro-magnet *n*, so that its spring or weight *t* will draw away its armature.

The movement of the armature *u* may be made operative in effecting any desired telegraphic operation to which it is adapted. I, however, employ the same especially as a sounder, and in that case the battery *r* and circuit *k m* are local.

I am aware that contact-points within a liquid, such as oil or glycerine, have been employed in the circuit-breaker of an electric engine. In my improvement the circuit is not broken, but the relay-magnet or sounder is operated by rise and fall of tension, and the contact-points are adjustable instead of varying the armature-spring of the magnet.

I claim as my invention—

The adjustable contact-points acting within a liquid, in combination with the helix, armature, and spring of a sounder or relay, as set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

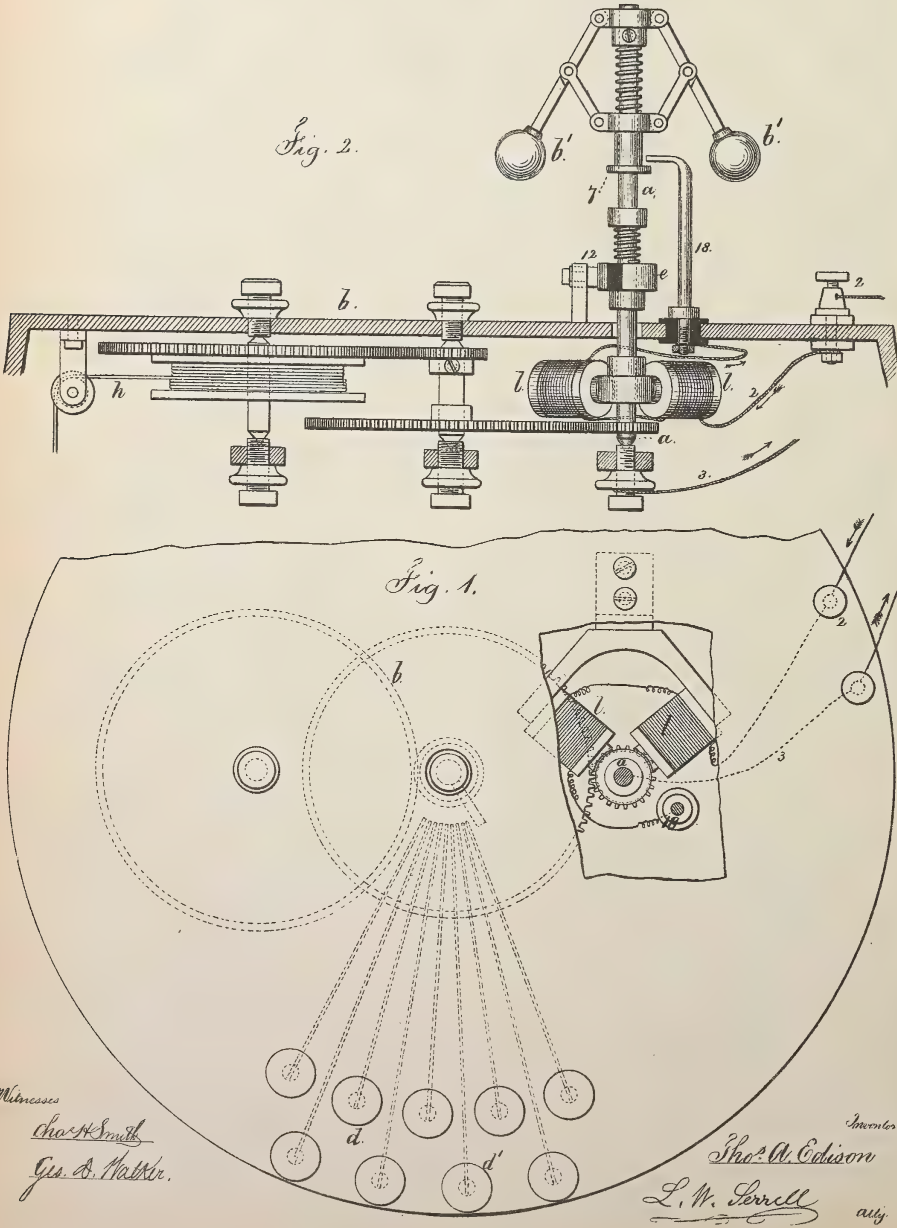
GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Electrical Regulators for Transmitting Instruments.

No. 142,688. Patented September 9, 1873.



Witnesses
Chas. H. Smith
Geo. D. Walker.

Inventor
Thos. A. Edison
L. W. Serrell
atty.

A.M. PHOTO-LITHOGRAPHIC Co. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN ELECTRICAL REGULATORS FOR TRANSMITTING-INSTRUMENTS.

Specification forming part of Letters Patent No. **142,688**, dated September 9, 1873; application filed March 13, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraph Transmitting-Instruments, of which the following is a specification:

This invention relates to means for regulating the speed of the pulsator-shaft in that class of transmitting-instruments in which said shaft is revolved by an electromotor, weight, or spring.

My improvement consists in employing an electro-magnet with its cores contiguous to the pulsator-shaft to check the speed of said shaft when it exceeds its maximum or determined rate by the magnetism of the cores attracting said shaft and retarding its movement.

The circuit to the electro-magnet is closed by the governor on the shaft rising by the increase of speed and bringing a flanged sleeve in contact with an insulated post, and opened when their contact is broken by the slight diminution in speed of the shaft, and consequent fall of the governor and its sleeve, when the electro-magnet ceases its action upon the shaft.

In the drawing, Figure 1 is a plan, and Fig. 2 is a section of part of a transmitting-instrument sufficient to illustrate my improvement.

b represents the bed of the instrument, and beneath this is a train of gearing for revolving the pulsator-shaft *a*, said gearing being operated by a weight at the end of the cord or rope *h*; or my improvement is equally available where the pulsator-shaft is revolved by an electromotor, or by a spring and gearing.

The pulsator *e* upon the shaft *a* acts with the circuit-closing lever or spring 12 to open and close the main-line or local circuit, as in my patent No. 131,343, and a reference is hereby expressly made to the same for the action of this pulsator, and for the construction and operation of the finger-keys *d d'*, shown by dotted lines in Fig. 1, as the aforesaid patent sets these parts forth and the objects accomplished.

The electro-magnets *l* for regulating the speed of the shaft *a* are placed with their cores contiguous to an iron or steel hub on said shaft, as shown in Fig. 1, and the enlargement of the shaft at this point gives ample metallic surface for the magnetism of the cores to act upon. These magnets *l* are in a local circuit, 2 3, connected with the shaft *a*, and also to the insulated post 18. *b'* is the governor revolving with the shaft *a*, and provided with a sleeve, upon which is a flange, 7, as in aforesaid patent. As the governor rises by increase of speed, the flange 7 comes in contact with the end of the insulated post 18, and closes the circuit to the magnets *l*, which, by their attraction upon the shaft *a*, retard its speed. This slight diminution of speed causes the governor-ball to fall and breaks the circuit at 7 18, and upon the speed again increasing the circuit is again closed by 7 and 18 coming in contact, and the speed is checked, as before.

In the aforesaid patent the contact of 7 and 18 by increased speed lessens the current to the motor. In the present instance the magnetic brake formed by the magnets *l* checks the speed. The cores of these magnets might be loose within the helices; or the magnets might be upon a spring-arm, so as to be brought into contact with the shaft by the attraction, if desired.

I claim as my invention—

The speed-regulator consisting of the electro-magnet *l*, shaft *a*, and governor, in combination with the circuit-closer and pulsator, substantially as and for the purposes set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Galvanic Batteries.

No. 142,999. Patented September 23, 1873.

Fig. 1.

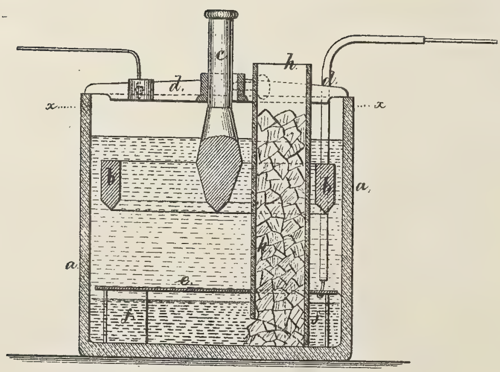
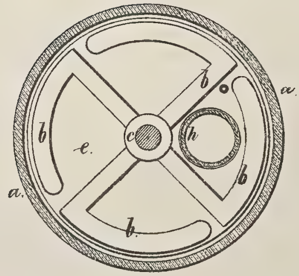


Fig. 2.



Witnesses,

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison

Lemuel W. Serrell

atty.

AM. PHOTO-LITHOGRAPHIC Co. N.Y. (OSBORNE'S PROCESS)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN GALVANIC BATTERIES.

Specification forming part of Letters Patent No. **142,999**, dated September 23, 1873; application filed November 5, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Galvanic Batteries, of which the following is a specification:

Galvanic batteries have been made with a plate of copper at the bottom of the glass jar in which the zinc is suspended. The zinc has been attached adjustably by arms, and the copper in some instances has been a plate placed edgewise in the bottom of the cell. In all instances the sulphate of copper has been placed around and above the copper plate, and in practice it is found that the zinc becomes discolored and its efficiency is injured by a coating or deposit from the blue vitriol. I have discovered that when the sulphate of copper is placed below the copper pole of the battery the zinc pole will remain more efficient and free from deposit, that the blue-vitriol solution in the liquid of the cell will not extend above, or but little above, the copper plate, and that the battery will not require replenishing as rapidly as now usual, and will remain at a more uniform intensity.

In the drawing, Figure 1 is a vertical section, and Fig. 2 is a sectional plan, at the line *x x*, of my said battery.

The cup or cell *a*, zinc *b*, suspending-rod *c*, arms *d*, and clamp are to be of any usual character.

In carrying out my improvement, I support or suspend the copper pole *e* at a short distance from the bottom of the cell, say one inch, more or less. To effect this, the copper pole may have legs, *f*, resting upon the bottom of the cell, or the same may be suspended by non-conducting material, such as hard rubber, from the edges of the vessel *a*, or from the zinc pole or its support. The sulphate of copper is to be supplied below the copper pole, either by inserting the same before introducing the copper, or it may preferably be supplied through the tube *h* that passes by the copper pole, so that the sulphate of copper introduced through the same remains below the copper and the metallic copper is deposited, and the zinc is acted upon by the acid that is liberated without the deposit of foreign matter resulting from the direct contact of the sulphate of copper with the zinc.

I do not claim a copper pole resting on short projections that serve to keep the same above any impurities in the cell.

I claim as my invention—

The arrangement, in a galvanic battery, of the horizontal copper plate above the sulphate of copper and its solution, and below the zinc pole and the liquid surrounding the same, for the purposes and substantially as set forth.

Signed by me this 31st day of October, A.D. 1872.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

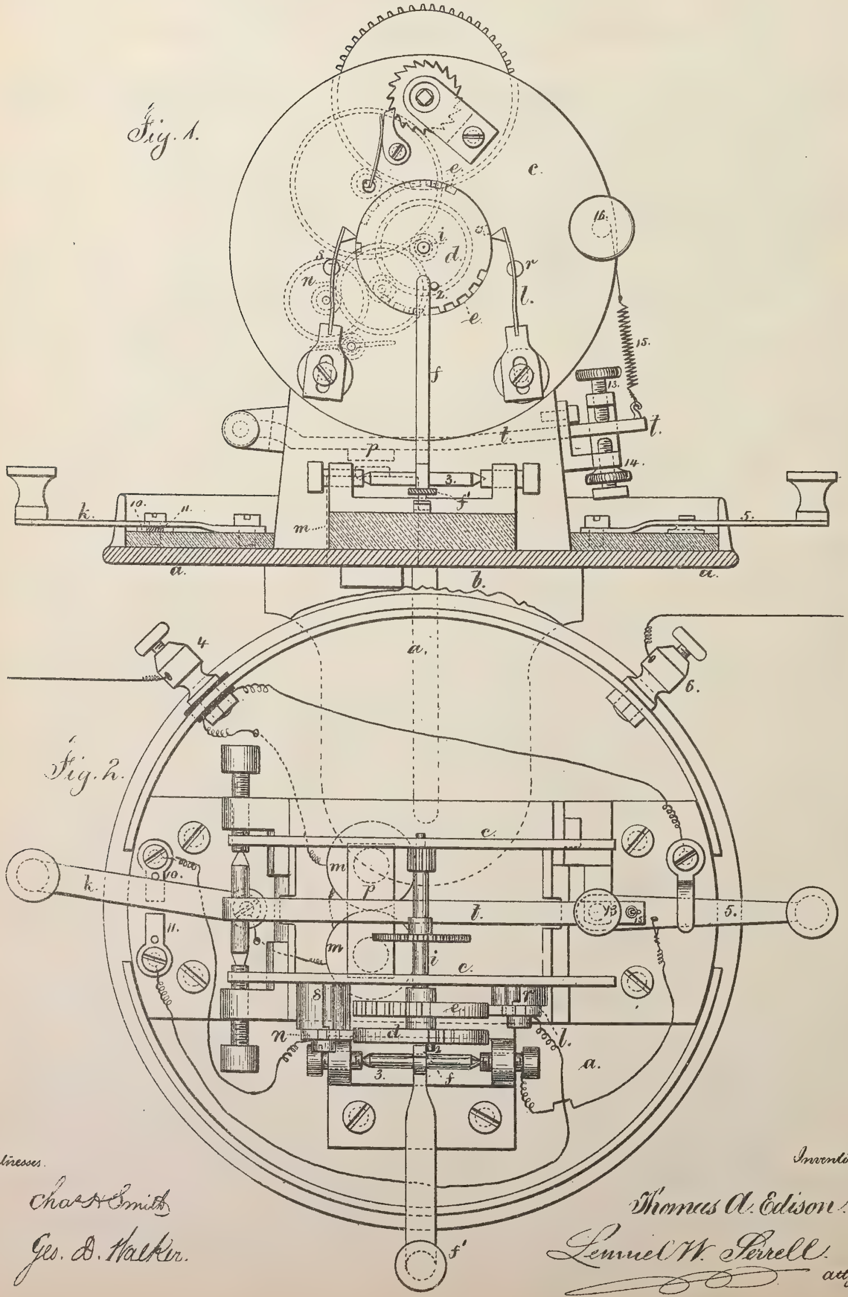
T. A. EDISON.

Telegraph Signal-Boxes.

No. 146,812. Patented Jan. 27, 1874.

Fig. 1.

Fig. 2.



Witnesses.

Chas. H. Smith

Geo. D. Walker.

Inventor

Thomas A. Edison.

Lemuel W. Serrell. atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO AMERICAN DISTRICT TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN TELEGRAPH-SIGNAL BOXES.

Specification forming part of Letters Patent No. **146,812**, dated January 27, 1874; application filed December 3, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Alarm and Signal Apparatus, of which the following is a specification:

Before my invention, an alarm apparatus and local telegraph had been invented for communicating from several houses or buildings in a telegraphic circuit with the central station, for calling police, messenger, or other service, as seen in Letters Patent No. 127,844, granted to E. A. Calahan. My invention is an improvement upon the same, and a modification of Letters Patent No. 129,526; and consists in an adjustment to the springs that close the circuit, whereby the V-shaped ends are properly positioned, and the power of the springs regulated. Also, in arranging the magnet, armature, and adjustable stops in relation to the clock-work so that the parts are easy of access, and the sound from the moving armature will be unconfined.

In the drawing, Figure 1 is an elevation with the bed in section; and Fig. 2 is a plan with the clock-work or train of gearing removed.

The base *a* is made circular, and adapted to receiving a glass shade to protect the machine from dust; and the base is sustained by a bracket, *b*, that can be screwed to a window or door frame, or other convenient support. The plates *c c* are connected to the base *a*, and carry the spring-barrel and train of gearing, of any usual character, to rotate the shaft *i* and brake-wheels *d* and *e*. There is a stop-pin, 2, upon the wheel *d* that is arrested by the lever *f*, which lever *f* is mounted upon the insulated cross-shaft 3, and provided with a finger-key, *f'*, ouside the base, so that, by depressing the said key *f'* the lever *f* is moved, the pin 2 liberated, and the train of gearing allowed to move, and revolve the wheels *d* and *e*. The same movement breaks the electric circuit that ordinarily passes from the binder 4, through the insulated switch 5 and wire, to the lever *f*; thence, through the pin 2 and clock-work and bed, to the binder 6.

In the brake-wheels *d e* are notches, positioned to give indications upon a suitable instrument at the central receiving-station—such as a bell-magnet, armature, and hammer—to designate, by the strokes on the bell, the number allotted to the wheel *d*, or to the wheel *e*, and, in so doing, indicate the station at which the instrument is placed containing such numbers; and, also, what is wanted—such as police or messenger.

The switch *k* is employed to direct the circuit through either the wheel *d* or the wheel *e*, according to what is to be indicated at the receiving-station. I remark that the contact-blocks 10 and 11 of the switch are sufficiently near each other for the circuit not to be broken in the act of moving the switch from one contact-block to the other.

The circuit-closing springs *l n* are upon insulated blocks, and connected by clamping-screws passing through slots, so that the V-shaped ends of such springs can be adjusted in their position vertically; and also in the force with which they press against the respective wheels *d* or *e*. There are insulated stops *r s* provided to limit the movements of the springs *l n*, and prevent the V-ends of the springs moving too far into the slots in the circuit-wheels *d e*, thereby insuring the proper length of pause between the pulsations.

The electro-magnet *m* is in an opening in the base *a* below the clock-work, and it is provided with an armature, *p*, and lever *t*, having a limited motion between the adjusting-screws 13 14, and the retractile spring 15 is adjusted by the shaft 16, that passes through the frames *c*. This arrangement renders the parts very compact, gives access to the magnet from below, and brings the moving end of the armature-lever where it can be seen, and the sound thereof against the screws 13 14 will not be confined.

The connection from the binder 4, through the insulated switch 5 to the lever *f*, ordinarily remains closed, and forms a shunt to the main line, cutting out the electro-magnet; but, when broken at 5, the current is compelled to go through the electro-magnet *m*, producing a motion of the armature, and sound. This switch 5 is, therefore, only employed by an operator

to ascertain whether or not the line is in use by any other instrument, by compelling any pulsation to pass through his magnet, and if the electro-magnet is not vibrated the line is clear, and his own instrument can be started, and, by the electro-magnet responding, it will become apparent that the line is in proper condition.

I claim as my invention—

1. The circuit-springs *l n*, attached by slots and screws, so as to be adjustable in their length and power, as set forth, in combination with the wheels *d e*, as specified.

2. The combination of the electro-magnet *m* beneath the clock-work, the adjusting armature-lever, screws 13 14 outside the clock-work, and the shaft 16, for adjusting the spring 15 above the lever and through the clock-plates *c c*, all arranged as and for the purposes set forth.

Signed by me this 26th day of November, 1872.

THOMAS A. EDISON.

Witnesses:

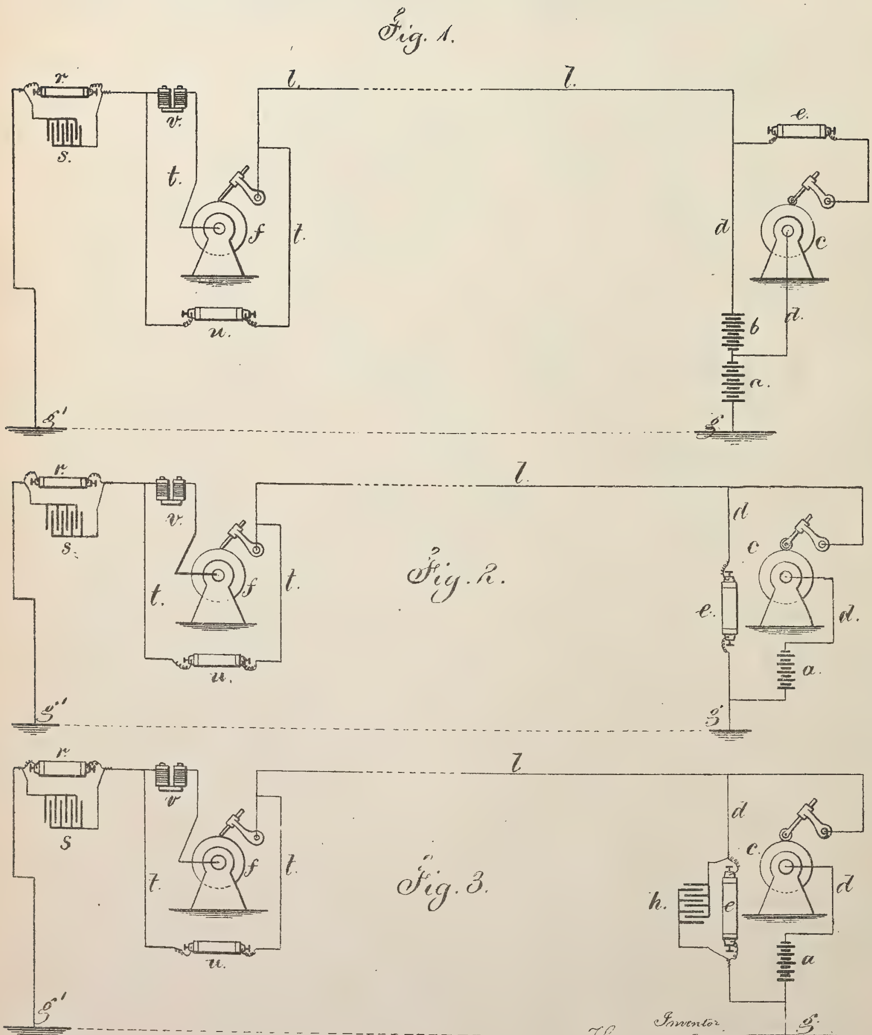
GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Electric-Telegraphs.

No. 147,311. Patented Feb. 10, 1874.



Witnesses
Chas. H. Smith.
Harold Serrell

Inventor
Thos. A. Edison,
per Lemuel W. Serrell
atty.

AM. PHOTO LITHOGRAPHIC Co. N.Y. (OSBORNE'S PROCESS)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN ELECTRIC TELEGRAPHS.

Specification forming part of Letters Patent No. **147,311**, dated February 10, 1874; application filed July 29, 1873.

CASE 82.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Electric Telegraphs, of which the following is a specification:

In cables and long telegraph-lines there is a limit to the speed with which perfect signals can be transmitted and received, whether the receiving-instrument consists of an electro-magnet, a galvanometer, a relay, or a chemical-telegraph instrument. This limit in speed arises from the fact that the moment the line or cable is charged by the battery being connected, a static charge is instantly set up, which is in an opposite direction to the dynamic charge, and the tendency is to defer the reception of the signal at the distant station, and at the moment of breaking the battery-connection, the static charge disperses by dividing at the center of resistance, and going in both directions, one part going to the ground at the transmitting station in a direction opposed to the battery, and the other part going toward the receiving-instrument in the same direction as the previous current from the battery. This electrical condition is of sufficient duration to render the signals unintelligible at the receiving-instrument after a certain speed is attained. The time of discharge is directly proportioned to the resistance at the points of discharge at the ends of the line, and the result is that the speed of the instruments is limited to the speed with which the line will free itself through the channels aforesaid.

My invention relates to the discovery of a method of neutralizing the effects of the static charge in any length of line or cable, by balancing the electric forces, and the discovery of a point of no electric tension or zero, as regards the static charge, so that the receiving-instrument, when located at that point, will be operated by the rise of tension produced by a pulsation that is connected at such receiving-instrument, and made as instantly and definitely operative as the pulsation given at the transmitting station.

I obtain this point of no tension by forming at the receiving end an artificial line, having an equal or nearly equal resistance and electro-static capacity, or capacity for producing static charges, as that of the cable or land line, and connect this with the line or cable, and place between the cable and the artificial line the receiving-instrument, which hence is in the center of resistance and static accumulation. When this balance is obtained, the signals are received perfect, and the rapidity is governed only by the strength of the battery.

The artificial line is made with an adjustable rheostat; liquid in a tube is preferable. I connect, between the receiving-instrument and the earth, one or more condensers, or other accumulators of static electricity, which are made adjustable by having them in sections, and bringing one or more sections in or out by a switch, so as to increase or decrease the static charge from the artificial cable. It may also be done by placing a very high adjustable resistance-coil between one leaf of the condenser and the artificial line. I maintain a very low resistance between the line and the ground at the transmitting station, so as to discharge the static current at this end as rapidly as possible.

The mode which I prefer is to keep my transmitting-battery in circuit at all times, and include in the same circuit another battery of equal power with opposite poles, so that, when both are in, there is no current generated, and the resistance of the wire to earth is no more than the resistance of the battery. The transmission of a pulsation is made, when the circuit is closed, through the perforation in the paper, or otherwise, so as to short-circuit or shunt the neutralizing battery, and send a current upon the line. The current at the receiving-paper is shunted through a resistance, so as to preserve a constant and equal resistance, which the chemical receiving-paper does not give, owing to being more damp in one place than another. In balancing the resistance and static current, the resistance of the instrument is to be added to the line, and the resistance of the two equalized by the

same amount of resistance in the artificial cable or line. If the receiving-instrument is out of the center of resistance toward the line, the pulsations will be weakened by the static charge acting against the pulsation; but if the instrument is toward the artificial cable on the other side of the zero-point, the signals or characters will be slightly prolonged, owing to the static charge discharging in the same direction as the current. It is at this point that I prefer to place the instrument, because, by placing an electro-magnet in the shunt of the receiving-instrument, I obtain enough counter-discharge from that magnet to cut off this prolongation locally, and this discharge from the magnet will not interfere with the line, but has only a local effect on the receiving-instrument to prevent tailing on the chemical paper.

In the drawing, Figure 1 illustrates my invention in the form that I find most generally available. The batteries *a* and *b* are connected in opposite positions, the positive poles being toward each other, and the negative poles connected to the ground *g* and line *l*, respectively. The transmitting-instrument *c* is in a circuit, *d*, to the battery *b*, in which circuit *d* is a resistance, *e*. When the circuit *d* is broken, the two batteries *a b* neutralize each other, and there is no charge sent on the line; but when the circuit *d* is closed through a perforation in the paper, or by a key, or otherwise, the battery *b* is short-circuited, and the battery *a*, being unbalanced, sends a pulsation on the line. The artificial line between the receiving-instrument *f* and the earth *g'* is made by introducing a resistance or rheostat at *r*, preferably a tube containing liquid, with adjustable points. This rheostat is made to balance or equal, or nearly so, the resistance of the line *l*, and the instrument *f* and the condenser *s*, or other accumulator of static electricity, is of a capacity to about equal that of the line; hence the receiving-instrument will occupy a zero or neutral point in regard to the static charge, from which the static charges will discharge both ways to *g* and *g'*. The condenser or accumulator *s* should be in sections, to bring in a greater or less number of sections by switches. When the receiving-instrument is chemical, the paper is preferably prepared by dipping it in a solution of at least one pound of iodide of potassium in one gallon of water, to which is added a small quantity of flour. This paper cannot be maintained at uniform moisture; hence its resistance to the passage of electricity varies. This is compensated for by the shunt-circuit *t*, in which is a resistance, *u*, sufficient to direct the necessary amount of electricity to the paper to make the mark, and allow the remainder to pass to the artificial line. Thus the varying condition of the paper does not change the resistance of the line.

I have discovered that when an electro-magnet is energized, and the circuit broken, a pulsation is set up in the opposite direction to that passing into such magnets. I avail of this to prevent tailing upon the chemical paper, and at *v* I have shown an electro-magnet for this purpose. It will be seen that this electro-magnet will discharge itself within a short local circuit containing the receiving-instrument, and that the reactionary current therefrom, moving in the opposite direction to the main current, frees the receiving-instrument from the tailing caused by the discharge of static electricity, and this magnet *v* may be employed in many places to effect the object before named, even when there is not an artificial line. In some instances with very long lines, there may be intermediate artificial lines, arranged as aforesaid, or reactionary magnets with branch circuits to the earth, to either receive drop copies in such branch circuits or to free the line of static electricity, and aid in obtaining the signals perfectly at the last receiving station with the greatest rapidity. Figs. 2 and 3 represent the same parts as before described; but in Fig. 2 only a single battery is shown, and the resistance *e* is between the line and the earth, to regulate the proportion of electricity sent over the line, by adjusting such rheostat to prevent too great return to the battery through such rheostat. In Fig. 3 a condenser, *h*, is introduced in addition to this rheostat, that it may react between the pulsations of electricity on the main line to aid in clearing such line of the static charge.

I claim as my invention—

An artificial line between the receiving-instrument and the earth, to balance the resistance and static charge, or nearly so, at both sides of the receiving-instrument, substantially as set forth.

Signed by me this 23d day of April, A. D. 1873.

THOS. A. EDISON.

Witnesses:

GEO. D. WALKER,

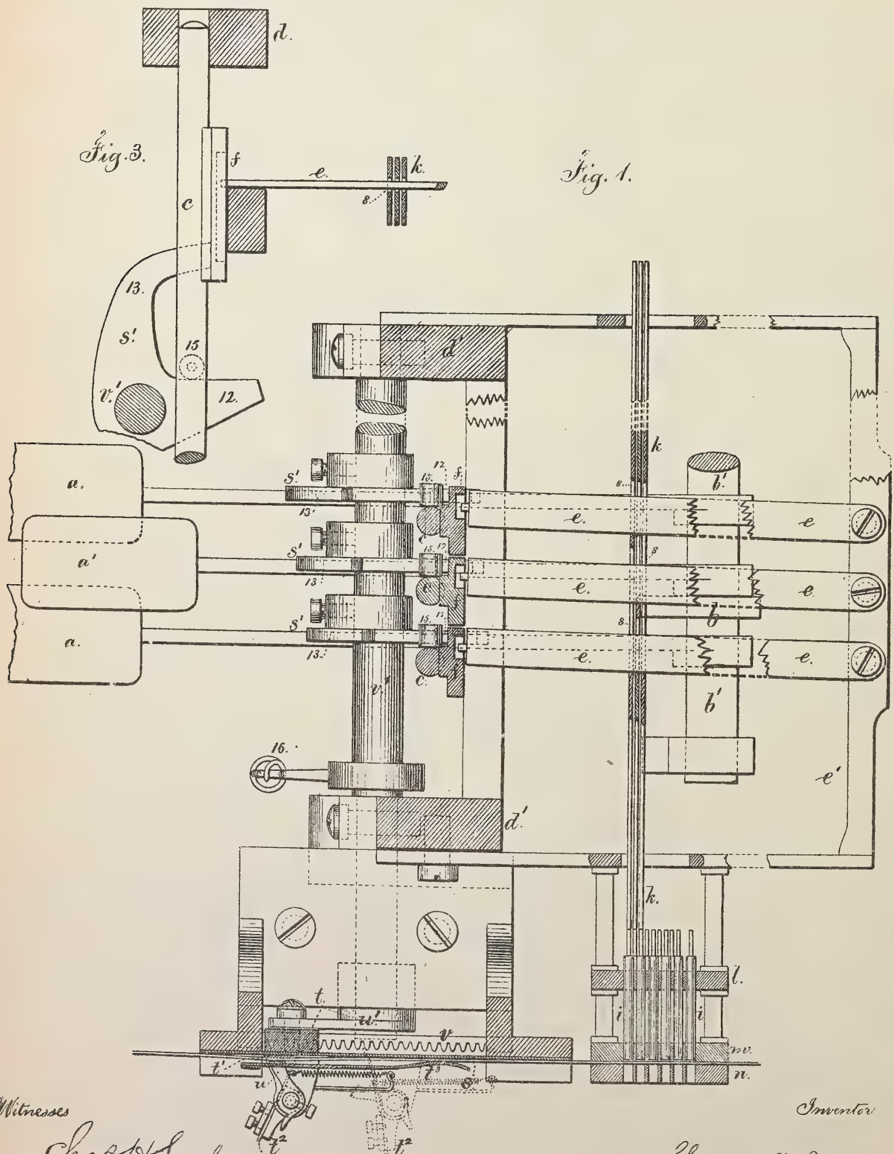
GEO. T. PINCKNEY.

2 Sheets--Sheet 1.

T. A. EDISON.

Perforators for Automatic Telegraphy.

No. 147,312. Patented Feb. 10, 1874.



Witnesses

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison

Lemuel W. Serrell

atty

AM. PHOTO-LITHOGRAPHIC Co. N.Y. (OSBORNE'S PROCESS)

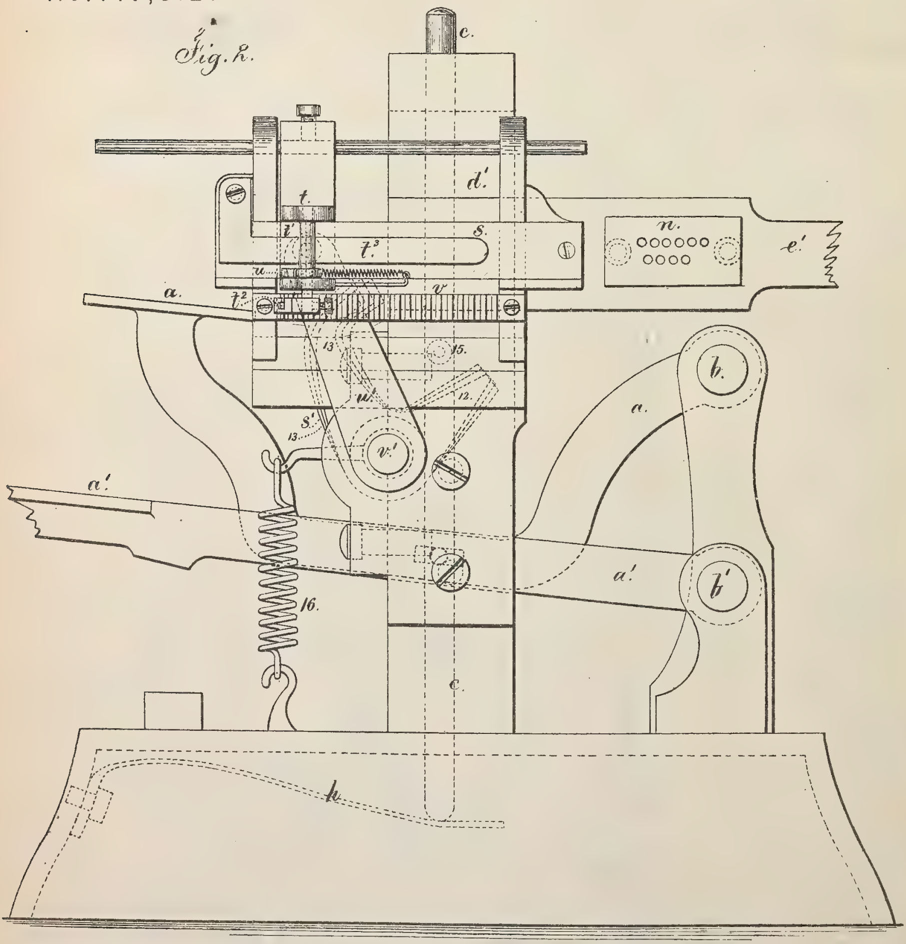
2 Sheets--Sheet 2.

T. A. EDISON.

Perforators for Automatic Telegraphy.

No. 147,312. Patented Feb. 10, 1874.

Fig. 2.



Witnesses,

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison

Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN PERFORATORS FOR AUTOMATIC TELEGRAPHY.

Specification forming part of Letters Patent No. **147,312**, dated February 10, 1874; application filed July 29, 1873.

CASE 75.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Machinery for Perforating Paper for use in Automatic Telegraphing, of which the following is a specification:

This invention is an improvement upon that set forth in Letters Patent No. 121,601, granted to me December 5, 1871, and a reference is hereby expressly made to said patent for a more full and complete description of those parts which are herein only generally referred to.

My present improvement relates to the paper-carrier which feeds the paper, and to the means for giving the feed-motion to said paper-carrier.

In the drawing, Figure 1 is a plan, partially in section, of a portion of my machine. Fig. 2 is an end elevation of the paper-feed and dies; and Fig. 3 is a detached section, showing one of the cams and slide-bars for giving the feed-motion, and also showing the cam for actuating the presser-lever.

The finger-keys *a a'* are in two ranges, and mounted on the fulcrum-shafts *b b'*, and to these keys the vertical slide-bars *c c* are jointed. The cams *f f* are secured to said slide-bars, and they actuate the presser-levers *e e* and slide-plates *k k*, which latter operate the punches *i*, that perforate the strip of paper in the die *m n*, and these parts thus far described are similar in construction and operation to the corresponding parts set forth in aforesaid patent. The rock-shaft *v'*, which gives motion to the paper-carrier, is mounted in the frame *d'*, and upon this shaft are the cams *s'*, one for each slide-bar *c*, and each cam is made with the arms 12 and 13, and is upon a hub clamped to said shaft by a set-screw. The roller 15 upon the slide-bar *c* takes against the arm 12 of *s'*, and gives a partial rotation to the shaft *v'*, when the bar *c* is moved by a finger-key being depressed, and the amount of motion given to said shaft is determined by the arm 13 of *s'*, which comes against the rear of the cam-plate *f* on *c*, as shown in Fig. 3, or against the bar *c* itself, and acts as a stop to prevent the shaft being turned beyond the point necessary for giving the proper motion to the paper-carrier *t*.

These cams *s'* are easily adjusted upon the shaft *v'*, and each cam is positioned so that when a finger-key is depressed, said shaft is only turned the amount required for moving the carrier *t*, and feeding the paper for the character that is perforated by the depression of that key.

The rock-shaft *v'* gives motion to the paper-carrier *t* by the arm *u'*, and this carrier is made with a thin metal plate, t^1, which moves in front of the fence *s*, and to this plate t^1 the paper is clamped by the pawl *u* when said paper and carrier are moved forward, and said pawl is turned and lifted from off the paper and plate when the carrier is moved backward.

To operate this pawl *u*, I employ the spring-arm t^2 and rack *v*, and this arm is secured to the pivot upon which the pawl *u* turns. As the carrier *t* moves backward, the end of the arm enters between two of the teeth of *v*, and said arm being diagonal to said rack *v*, the arm yields to accommodate itself to the movement of the carrier, and in so doing acts as a lever and swings the pawl *u* off of the paper to the position shown by dotted lines in Fig. 1. The pawl *u* is kept in this position by the end of the arm t^2 riding over the teeth of the rack during the entire backward movement of the carrier. Upon the carrier moving forward, the spring-arm swings the pawl *u* and brings it in contact with the paper, and clamps it firmly to the plate t^1, and said paper is fed or carried forward by said plate and pawl, the spring riding t^2 over the ends of the teeth and holding the pawl to the paper. The spring t^3 keeps the strip of paper in its proper position against the fence *s*, and, by its friction, prevents the paper being carried by momentum after the carrier stops.

The operation of this machine, as before mentioned, is similar to that set forth in aforesaid patent, the punches *i* perforating the paper during the time the carrier is moving back-

ward, and this backward movement is a distance equal to the space for the character that is perforated and the intervening distance. The spring 16 returns the parts to their normal position, and I remark that by this construction the adjustment of the paper-feed is very easily made, and the parts are light and not liable to become injured or disarranged.

I claim as my invention—

1. The stops 13 and cam-arms 12 upon the shaft v', in combination with the finger-keys a a', slides c, rollers 15, and paper-feeding mechanism, substantially as and for the purposes set forth.

2. The spring-arm t^2 upon the pawl u, in combination with the rack v and reciprocating mechanism, substantially as set forth.

Signed by me this 24th day of March, A. D. 1873.

THOMAS A. EDISON.

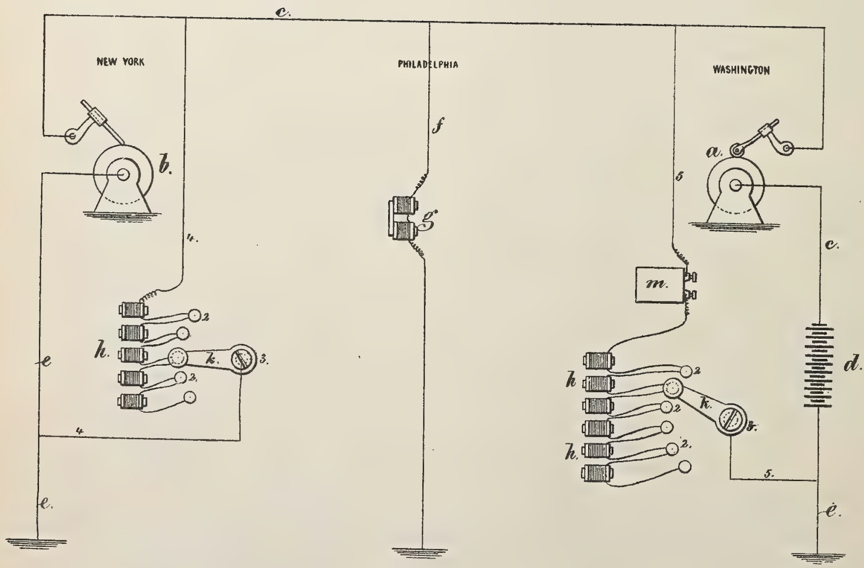
Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.
Chemical Telegraphs.

No. 147,313. Patented Feb. 10, 1874.



Witnesses,
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison
Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **147,313**, dated February 10, 1874; application filed July 29, 1873.

CASE 71.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphs, of which the following is a specification:

In Letters Patent granted to me February 4, 1873, and numbered 135,531, a helix or magnet is employed in a shunt or derived circuit to neutralize the attenuations of the pulsations in the main circuit, and prevent the tailing upon the chemical paper.

The object of the present invention is to adjust the counter or reacting force of the magnets or helices at the receiving station, and also to adjust the reacting force of the magnets or helices at the transmitting station, so as to vary the action of the helices to suit the battery or the conditions of the pulsations at the transmitting and receiving stations.

In the annexed diagram, *a* is the transmitting-instrument, in which the strip of perforated paper is employed to make and break the circuit. *b* is the receiving-instrument for the strip of chemical paper. *c* is the main line; *d*, the main battery; *e e*, the ground-connections. *f* is a branch circuit to the earth, in which the induction-coils or magnets *g* are introduced, as in aforesaid patent. *h* are the induction-coils at the receiving station, and the action of the same corresponds with that set forth in said patent. I, however, employ several electro-magnets or induction-coils, connected together through the contact-pins 2 2, and these are arranged in the arc of a circle, of which the fulcrum 3 of the switch *k* is the center, and to this center 3 one of the shunt-wires 4 connects. By moving this switch *k*, one or more of the helices is placed in the shunt-circuit, and the reactionary effect in clearing the line or instrument of tailing is thereby increased or decreased, as required.

At the transmitting-station the shunt-circuit 5 is provided with the resistance or rheostat *m*, and the electro-magnets or induction-coils *h*, switch *k*, and contact-pins 2 2, so that there may be more or less reactionary effect of the helices *h* to cut off the tailings upon the main line, because, when the circuit is closed at the transmitting-instrument *a*, a large portion of the battery-power passes through the shunt 5, switch *k*, coils *h*, and rheostat, and there is an accumulation of energy in the helices *h*, and as soon as the circuit through the instrument *a* is broken, the magnets *h* discharge themselves with more or less power, according to the number of said helices that are brought into the circuit; and this discharge, being in an opposite direction to the current of the battery, acts to clear the line of any surplus or static electricity, and prevent tailing.

It will be evident that the reactionary effect of the induction-coil or magnets in the shunt-circuit at the transmitting station is to neutralize static electricity, or to bring the line to a normal electric condition instantly, thereby greatly promoting the rapidity of action.

Either the positive or the negative of the transmitting-battery may be to the line, and the other pole to the earth; but the connections of the receiving-instrument must be made accordingly.

I claim as my invention—

1. A shunt or derived circuit at the transmitting station, into which an adjustable resistance and one or more electro-magnets are introduced, as and for the purposes set forth.

2. The combination, with a chemical telegraphic receiving-instrument, of several electro-magnets and a switch, *k*, to connect more or less of said magnets in a shunt-circuit, for the purposes set forth.

Signed by me this 23d day of April, A. D. 1873.

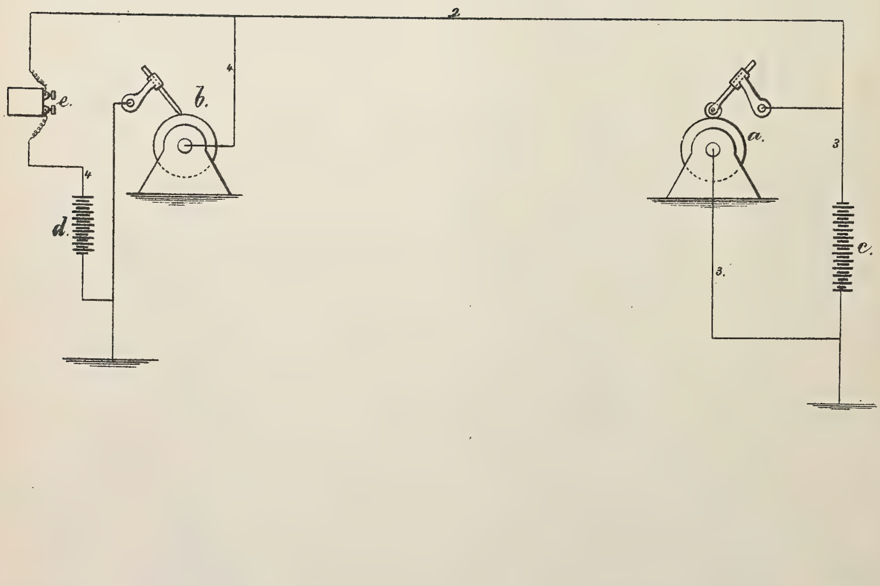
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Circuits for Chemical Telegraphs.

No. 147,314. Patented Feb. 10, 1874.



Witnesses,

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison

per Lemuel W. Serrell

atty

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS)

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CIRCUITS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **147,314**, dated February 10, 1874; application filed July 29, 1873.

CASE 77.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Circuits for Chemical Telegraphs, of which the following is a specification:

This invention is for use in automatic telegraphing in which perforated paper is employed in transmitting, and chemical paper in receiving, the message.

The receiving and transmitting instruments are in shunt-circuits from the main line, and in each circuit there is a battery. These batteries act in opposition to each other, and produce no effect at the receiving-instrument when the shunt-circuit is broken at the transmitter. When this circuit is closed, the current from the battery of the transmitter is short-circuited, and does not pass over the line. This destroys the balance of electrical tension, and the battery at the receiving end of the line acts upon the chemical paper and makes the mark.

In the diagram, the transmitting-instrument is represented at *a*, and the receiving-instrument at *b*, and these are of usual character for transmitting by perforated paper, and receiving by chemical paper. The transmitter is in the circuit 3 to the battery *c*, and the receiver is in a circuit, 4, to the battery *d*, and the main line 2 is connected to these circuits, 3 and 4. The poles of the batteries *c d* are placed so that said batteries oppose each other, and when the strip of perforated paper intervenes between the stylus and drum of the transmitter the circuit 3 is broken, and the current from the battery *c*, over the line 2, and through the receiving-instrument *b* to the earth, is equaled by the current from the battery *d*, and hence no mark is made upon the chemical paper of the receiving-instrument *b*. The rheostat *e* is introduced in the shunt-circuit 4, and should be adjustable, so that the electric energy from the battery *d* may balance that from the line 2, and prevent decomposition in the chemical paper.

When the stylus or roller of the transmitter enters a perforation in the strip of paper, then the short circuit 3 from the battery *c* is closed, and the electricity passes but little upon the line 2. The battery *d* is now unbalanced, and its current, passing by the circuit 4 through the stylus of the receiver, makes the mark upon the chemical paper.

I claim as my invention—

The circuit 4 from the battery *d*, in which the receiving-instrument *b* is placed, in combination with the opposing-line circuit 2 and the shunt-circuit 3 at the receiving-instrument, in which are placed the transmitting-instrument and battery, as and for the purposes set forth.

Signed by me this 24th day of March, A. D. 1873.

THOMAS A. EDISON.

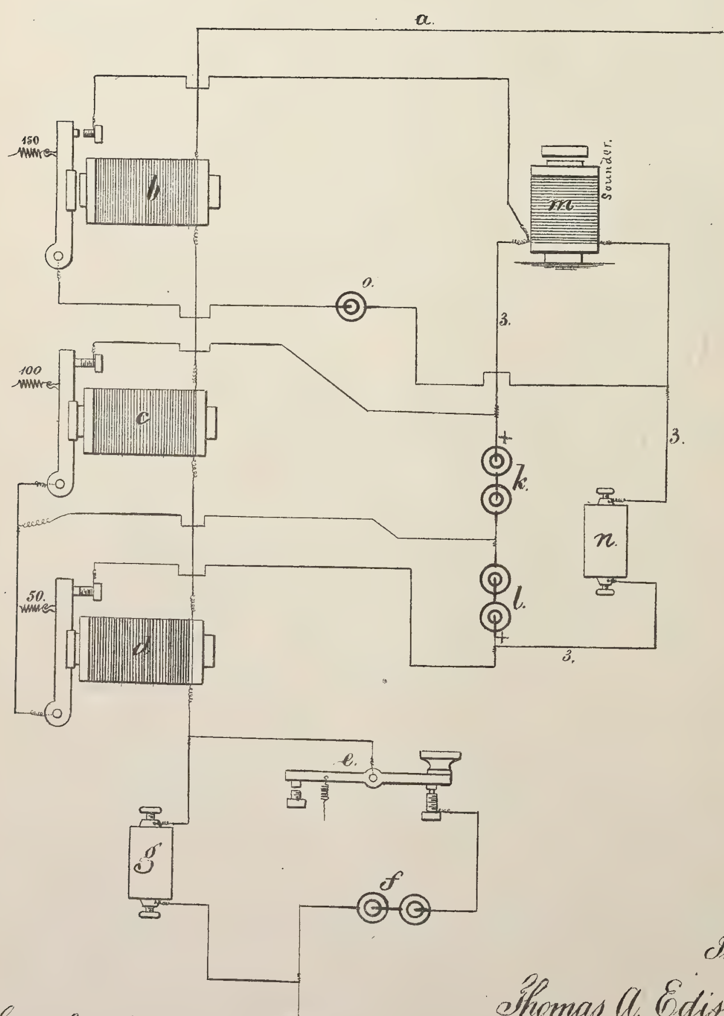
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Duplex-Telegraphs.

No. 147,917. Patented Feb. 24, 1874.



Witnesses

Chas H. Smith

Harold Serrell

Inventor.

Thomas A. Edison,

per L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **147,917**, dated February 24, 1874; application filed June 27, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented Improvements in Circuits for Duplex Electric Telegraphs, of which the following is a specification:

This invention is for enabling the operators at both stations to receive simultaneously, and that without the receiving-instrument being affected by the signals transmitted from the same station. I accomplish these objects by arranging the batteries, circuits, and magnets so that the receiving portion of the instrument will only respond to the pulsations from the distant instrument.

In the accompanying diagram, the line *a* is connected, through the electro-magnets *b c d*, to the key *e*, and the battery *f* is divided, half being at each station, as usual. *g* is a rheostat, to prevent the current being short-circuited, but always to maintain a connection of the line to the earth, even when the key *e* may be open. The batteries *k* and *l* are of equal power, and are connected in the circuit 3 in opposition to each other, and in that circuit is the sounder *m*, or other indicating-instrument or call. The battery *k* is connected with the armature circuit-closer operated by the magnet *c*, and the battery *l* with the armature circuit-closer of the magnet *d*. In the circuit 3 is a rheostat, *n*, of sufficient resistance to insure the electricity from the battery *o* passing through the sounder *m* when the circuit-closer of *b* is operated. The instruments at both ends of the line are the same and the adjustments correspond.

The armatures of *b c d* are adjusted to different tensions. Suppose, as an illustration, that the magnet *d* is operated by an electric energy of 50, the magnet *c* by an energy of 100, and the magnet *b* by an energy of 150, and that the power of the battery *f* is 100, but the signal received from one station at the other is only represented by 50. If, now, the operator closes key *e*, both the magnets *d* and *c*, by the power of *f*, respond, and make and break the circuits to the batteries *l* and *k*, and there is no action on the sounder *m* or the magnet *b*. If the operator at the distant station closes his key when the key *e* is closed, the electric tension is increased by the increased energy represented by 50; hence the magnet *b* responds by the joint current from both ends, and operates the sounder *m* by the battery *o*; but if the key *e* is open, the magnet *d* responds to the pulsation from the distant station and short-circuits the battery *l*, allowing the battery *k* to be unbalanced and to operate the sounder *m*. Thus the signal can be received from the distant station whether the key *e* is open or closed, and the operator can also hear the click of his own magnets *c d* without actuating the sounder *m*.

By this arrangement the operators at both ends of the line can be receiving and sending over one wire, and the sounder or receiving-instrument is only operative from the distant station, and it is operative as well when the key *e* is open as when it is closed, and vice versa.

I claim as my invention—

The batteries *k l o* and circuits and circuit-closers of the electro-magnets *b c d*, in combination with the electro-magnetic sounder or call *m* and key *e*, the parts being adjusted to operate substantially in the manner specified.

Signed by me this 23d day of April, A. D. 1873.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Telegraph Relays.

No. 150,846. Patented May 12, 1874.

Fig. 1.

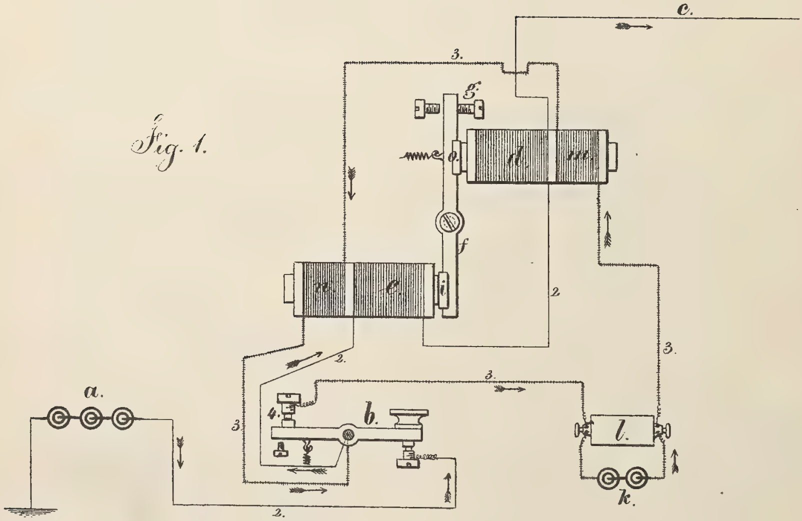


Fig. 2

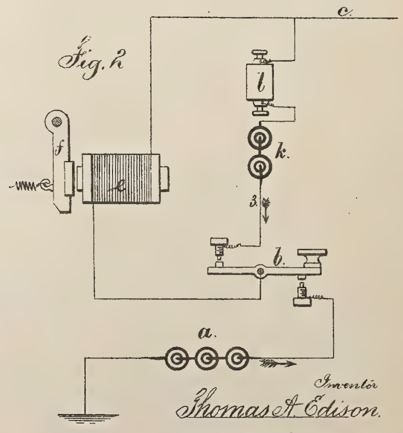
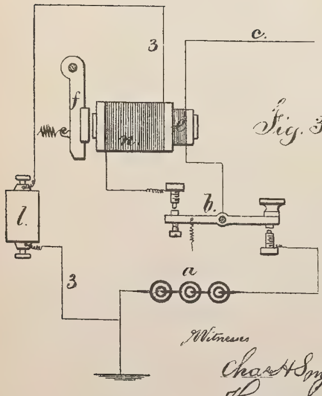


Fig. 3.



Witnesses
Chas H Smith
Harold Serrell

Inventor
Thomas A. Edison.
per L. W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN TELEGRAPH-RELAYS.

Specification forming part of Letters Patent No. **150,846**, dated May 12, 1874; application filed June 27, 1873.

CASE 81.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraph Instruments and Circuits, of which the following is a specification:

In the most usual way of arranging the circuits for telegraphing, the main-line batteries are nearly equal, and connected in the same line at the two stations, and the circuit composed of these batteries, the line, the instruments, and the earth, is broken or closed at either end to operate the instrument at the other end. In practice, this ordinary mode of arranging the circuits is found very troublesome, because the leaks from the line, especially in wet weather, return to one station, and hence the magnet of the sounder or other receiving-instrument is often powerfully energized when the circuit is broken at the distant station.

My invention is to overcome this difficulty; and consists in connecting, with the electromagnet, a reverse-acting circuit, that shall neutralize the effect of the escaping current when the instrument is at rest, and thereby maintain the electro-magnet in a condition to respond to the rise of electric tension when the main circuit is closed.

By adjusting the reverse-acting current, the magnet is maintained in the proper condition without resorting to the usual expedients of adjusting the spring, or the relative positions of the core and magnet, and deranging the conditions most favorable for rapid and reliable action in the magnet.

The diagram, Figure 1, in the accompanying drawing, represents the said improvement, and Figs. 2 and 3 show modifications.

The battery *a* and finger-key *b* connect with the line-wire *c*, through the helices *d* and *e*, by the wires 2, and the cores of these helices act upon the armatures *i* and *o* of the lever *f*, and, being at opposite sides of such lever and its fulcrum, the pairs of magnets can be made smaller, and act with greater rapidity upon such lever *f*, either to open and close another circuit at *g*, or perform any other duty. The battery *k* is provided with an adjustable rheostat, *l*, that is in the circuit 3, leading through the secondary helices *m n* of the electro-magnets *d e*, and to the anvil 4. The battery *k* acts in opposition to the current of the battery *a*, and hence tends to neutralize its action in the magnets *d e;* but the rheostat *l* is adjusted so that the current thereof only neutralizes any excess resulting from escape-currents.

The key *b* is to be kept closed when not in use, so that the circuits 2 and 3 will both be closed, and the reverse circuit from *k*, acting in *m n*, will only neutralize any magnetism resulting from the electricity escaping from *a*, through *e* and *d*, due to the defective insulation of the line; but, when the circuit is opened and closed at the distant station, the magnets *d e* will respond with promptness and accuracy by the rise in tension or energy.

By adjusting the rheostat *l*, it becomes unnecessary to adjust the tension of the armature-spring, or the relative position of the armature and core.

When the key *b* is employed in transmitting, the circuit 3 is opened and closed, as well as the circuit 2, to the main line; thereby the armatures will respond, and not be held, as they would by the action of the battery *k* and circuit 3, if that were not broken.

It will be apparent that the electricity of the reverse battery *k* and circuit 3 might be applied to the magnet *e* by a connection between the line and the key, as seen in Fig. 2, and the adjustment be made by the rheostat *l*, as before, or a coil, *n*, may surround the helix *e* of the magnet, wound in reverse directions, so that a portion of the main current passing through a shunt-circuit, 3, and adjusted by a rheostat, *l*, may react to neutralize the escape-current. The diagram, Fig. 3, shows this character of connection.

I claim as my invention—

1. The magnets *d* and *e*, arranged to operate at opposite sides of the armature-lever *f*,

in combination with the battery *k*, circuit 3, rheostat *l*, key *b*, and connections 2 thereto from the main line *c*, and the circuit 3, as set forth.

2. An electro-magnet connected in a circuit with a battery at both stations, combined with a rheostat and counter-current, to neutralize the effect in the magnet of a current arising from leakages in the line, substantially as specified.

Signed by me this 23d day of April, A. D. 1873.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Receiving Instruments for Chemical Telegraphs.

No. 150,847. Patented May 12, 1874.

Fig. 2

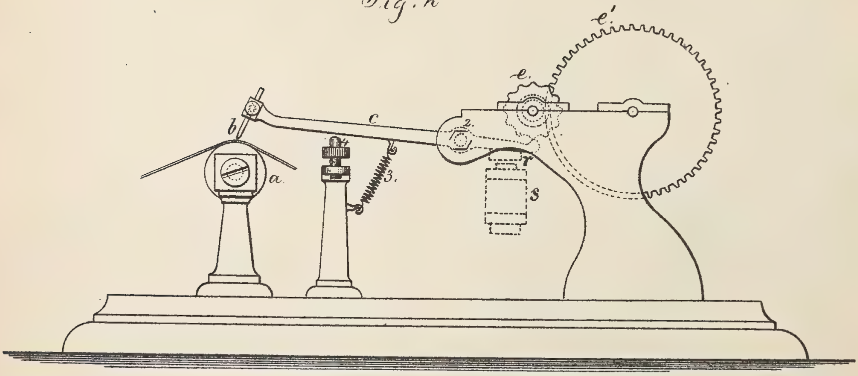
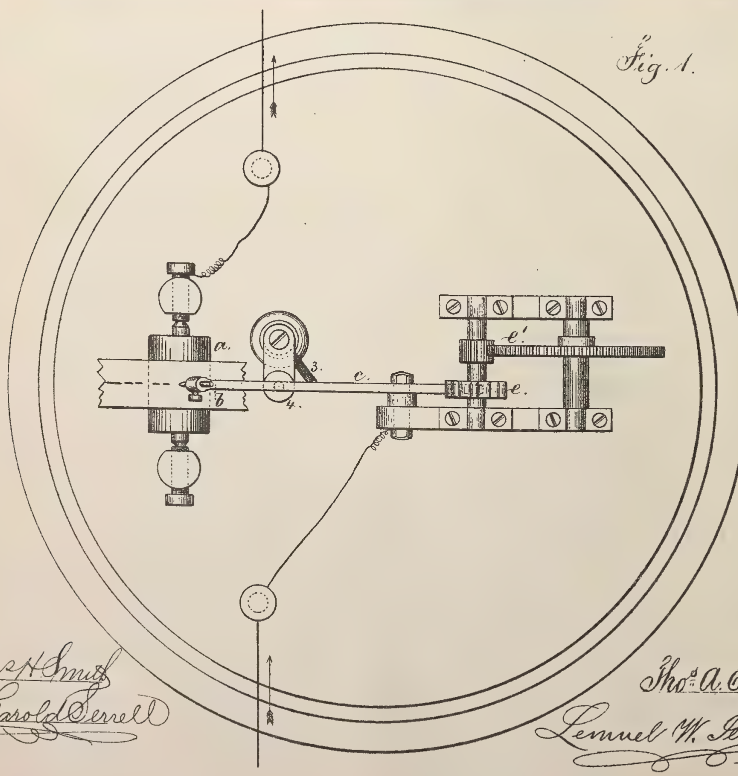


Fig. 1.



Witnesses
Chas H Smith
Harold Serrell

Inventor
Thos. A. Edison.
Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN RECEIVING-INSTRUMENTS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **150,847**, dated May 12, 1874; application filed July 29, 1873.

CASE 72.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Receiving-Instruments for Automatic Telegraphing, of which the following is a specification:

In automatic telegraphing, where perforated paper is employed for transmitting, and the message is received upon chemical paper, the marks made upon said chemical paper are often more or less blurred or tailed together when the speed of transmission is very rapid; and this is caused by the static charge or surplus electricity on the line acting upon the paper after the circuit is broken by the transmitter.

My present invention is made to lessen this blurring or tailing of the marks upon the chemical paper; and I accomplish this result by employing a stylus which is vibrated with great rapidity to make and break contact with the paper as the same is drawn along beneath such stylus.

This vibrating stylus offers no impediment to the electric wave or pulsation when the circuit is closed by the tranmitter; hence the mark is made upon the paper; but when the circuit is broken the surplus electricity on the line is not sufficiently powerful to produce any tailing to the mark, because the vibrating stylus is not long enough in contact with the paper for this weak portion of the current to decompose the chemical substances in the paper.

In the drawing, Figure 1 is a plan, and Fig. 2 is a side view, of a device which may be used for vibrating the stylus.

a represents the drum or roller of a receiving-instrument, and over this drum the strip of chemical paper is drawn, as usual. The stylus *b* is upon a lever, *c*, and this lever moves upon the fulcrum 2, and is vibrated very rapidly by the notched or toothed wheel *e* acting upon a projection or tooth upon said lever. The spring 3 aids in giving the downward movement to the lever and stylus, and insures the stylus touching the paper. An adjustable stop, 4, limits this downward movement of the lever and stylus. The wheel *e* may receive its rapid movement from gearing *e*′, operated by a weight, spring, or electro-motor, or the lever may be provided with an armature, *r*, and vibrated by an electro-magnet, *s*, (shown by dotted lines,) the circuit to which is opened and closed by the movement of the lever *c*.

When the circuit is closed at the transmitter by the stylus or roller entering a perforation in the paper, the electric pulsation or wave passes over the line to the stylus *b* and makes a mark upon the chemical paper, and the vibration of said stylus causes no material difference in the appearance of the mark made, because the current is strong so long as the circuit is closed, and it acts through said stylus the same as though it were resting on the paper all the time. When the circuit is broken at the transmitter, the surplus current which remains on the line prevents this portion of the current passing to the chemical paper; hence the tailing is not made to the mark.

I claim—

A stylus for a chemical receiving-instrument, in combination with mechanism for communicating to such stylus a rapid vibration toward and from the paper, for the purposes set forth.

Signed by me this 24th day of March, A. D. 1873.

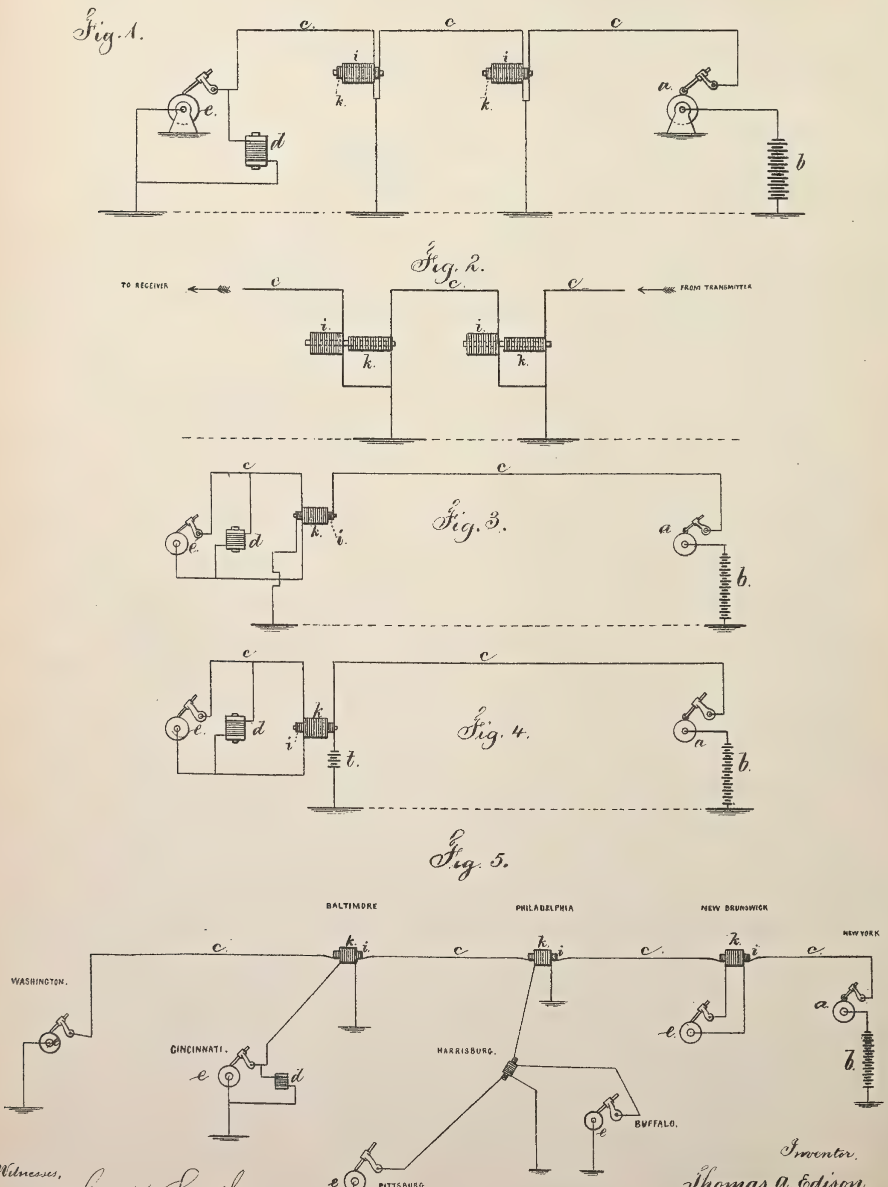
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS H. SMITH.

T. A. EDISON.

Chemical or Automatic Telegraphs.

No. 150,848. Patented May 12, 1874.



Witnesses,
Chas. H. Smith
Geo. T. Pinckney

Inventor,
Thomas A. Edison,
Lemuel W. Serrell atty

AM. PHOTO-LITHOGRAPHIC Co. N.Y. (OSBORNE'S PROCESS.)

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CHEMICAL OR AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **150,848**, dated May 12, 1874; application filed January 15, 1873.

CASE 64.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Circuits, of which the following is a specification:

It is well known that in the induction-coil of an electro-magnet or primary helix a secondary current is induced or set up, and that this can be conveyed over a wire, and will pulsate with the primary current through the magnet-helix.

In chemical telegraphs great rapidity can be obtained upon short lines, while upon long lines the speed is rapidly diminished by increasing the distance. The current required in chemical telegraphs and cables is comparatively weak. I therefore make use of the secondary current from an induction-coil of an electro-magnet or primary coil as a relay for continuing the transmission of the message in long lines, and that without lessening materially the rapidity, and without blurring the message, as received, by tailings resulting from surplus or static electricity in the line, as now usual in long lines.

By the means before mentioned, all mechanical devices and movements, such as armatures, levers, and relay circuit-closers, are dispensed with, and the electrical operation alone relied upon, and I am able to operate chemical-telegraph lines with a rapidity heretofore unsurpassed. I divide the line up into sections of suitable lengths—say, about four or five hundred miles each—employing a line from the transmitting-station as long as can be used to advantage, and then introducing an induction-relay, either reaching to the receiving-station or to the next induction-relay. In some instances I make use of the induction-relay in operating local or branch circuits.

In the drawing, *a* is the transmitting-instrument; *b*, the battery; *c*, the line-wire of the main circuit. *k* is the induction-relay, and *e* is the receiving-instrument.

The induction-relay is preferably of large wire with a large number of convolutions, so as to obtain an increased quantity in the induction-current. One coil may be outside the other coil, as shown in Figure 1, or the induction-coil *i* may be separate upon the same core, as the primary helix *k*, as seen in Fig. 2. The primary or main circuit passes through the helix *k*; thence to the earth. The secondary or induction circuit is connected from the coil *i* to line-wire and distant instrument, and also to the earth.

In Fig. 1 the entire line is represented as divided into three sections, the first one being operated by the primary current, and the second section by the induced current, which, in turn, operating in the second induction-relay, operates in the third circuit that extends to the receiving-instrument. The number of circuits operated by induced magnetism may be increased, and I remark that, in consequence of the instantaneous action of the induced current, the transmitting-machine has to be worked with great rapidity, and that the dot-alphabet is preferable to the dot-and-dash alphabet.

In Fig. 3 a single primary circuit is shown, with an induction-circuit to operate the receiving-instrument. A rheostat or adjustable rheostat may be employed to regulate the proportion of current passing to the chemical paper.

In Fig. 4 a battery, *t*, is applied to the line near the induction-relay, of less power than the transmitting-battery, and with the opposite pole to the line, so as to clear said line, with rapidity, of static electricity or attenuation in the pulsations. In this case the induced or secondary current is produced by the increase and decrease of the current.

In Fig. 5 the transmitting-instrument is illustrated as being at New York, and working to Washington, and at Philadelphia and Baltimore primary and secondary coils, so that the induced circuits set up at these places can work to Cincinnati and Pittsburg; and at Harrisburg an induction-coil that sets up a second induction-circuit to Buffalo.

At any of the receiving-stations there may

be an electro-magnet in a local circuit to set up a counter-circuit when the pulsation ceases, to prevent tailing, as shown at *d*.

If required, there may be branch circuits, resistances, and connections to the earth from either the primary or the secondary circuits, to aid in clearing the line of surplus electricity.

In rapid automatic telegraphy the secondary current, although but momentary, is of greater intensity when the primary current is prolonged, (as with a dash,) so that the difference between dots and dashes is apparent in the chemical paper; and in cases where the difference is not sufficiently apparent the dot-alphabet will be used.

I do not claim the secondary circuit acting in a magnet to produce a signal.

I claim as my invention—

A circuit for chemical telegraphs, composed of the primary circuit operated by the transmitting-instrument, and an induction-relay coil to act in the receiving-instrument by a secondary circuit, substantially as set forth.

Signed by me this 12th day of December, 1872.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets--Sheet 1.

T. A. EDISON.

Automatic Telegraphy and Perforators Therefor.

No. 151,209. Patented May 26, 1874.

Fig. 1.

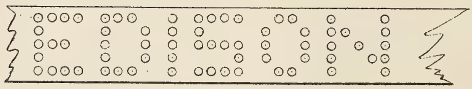
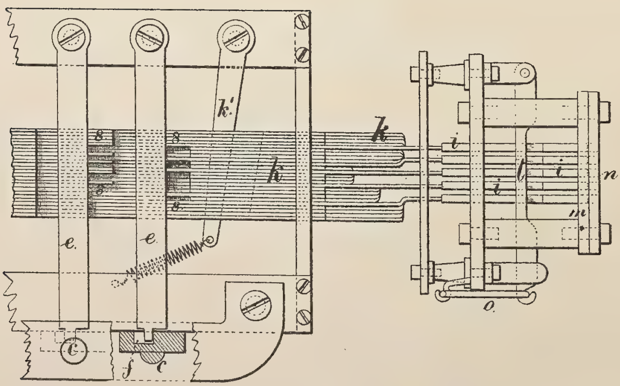


Fig. 2.

Fig. 3.



Witnesses,

Chas H. Smith

Geo. T. Pinckney

Inventor

Thomas A. Edison

per Lemuel W. Serrell

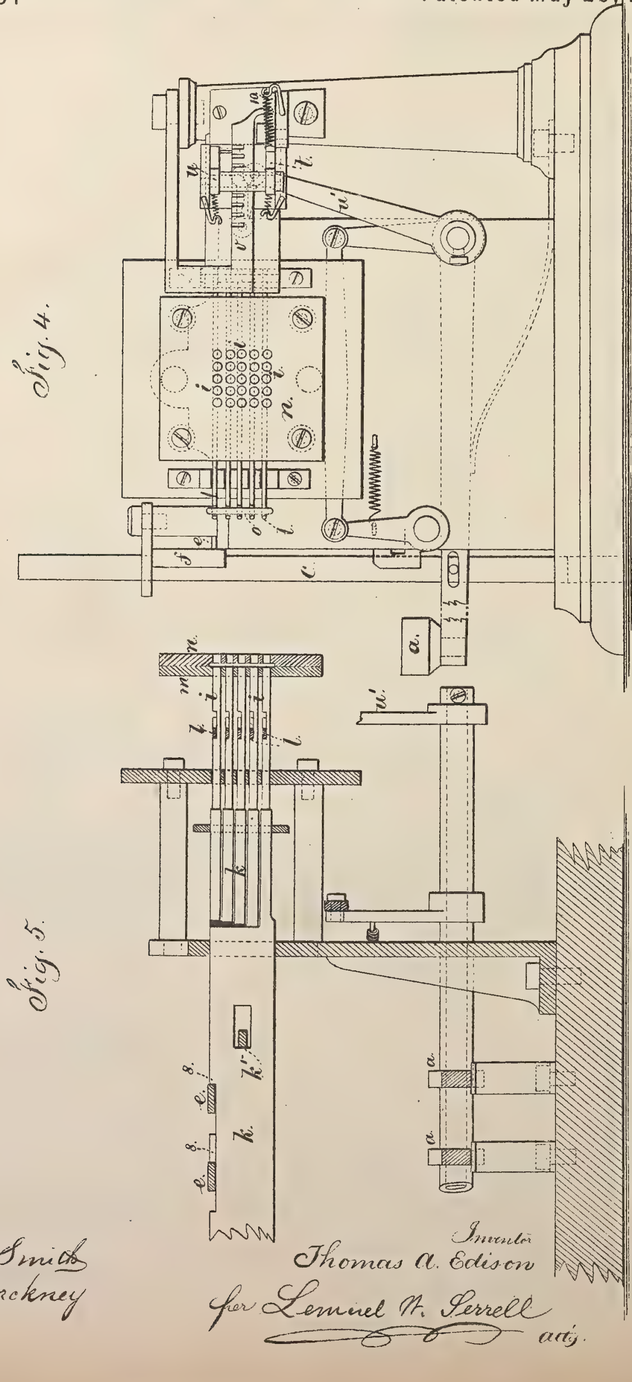
att'y.

2 Sheets--Sheet 2.

T. A. EDISON.

Automatic Telegraphy and Perforators Therefor.

No. 151,209. Patented May 26, 1874.



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN AUTOMATIC TELEGRAPHY AND IN PERFORATORS THEREFOR.

Specification forming part of Letters Patent No. **151,209**, dated May 26, 1874; application filed September 2, 1873.

CASE 83.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphing; and the following is declared to be a correct description of the same.

In the Morse system of telegraphy the operator frequently receives the message by sound, and writes the same out as received. In the printing-telegraph system, the printed strip itself is usually delivered as received. In the ordinary automatic system, the paper has to be punched or composed; and, at the receiving-station, the message on the chemical paper has to be translated and written out by hand, or printed by a key printing-instrument. Each system has its defects or disadvantages. The Morse system is slow, and requires a large number of wires. The printing-telegraphs are expensive, liable to inaccuracies and injury, and limited in speed to the fingering of the keys. The automatic system is rapid on the line, but the composing of the message and the writing of it out at the receiving-station are comparatively slow operations.

The object I have in view is to print the message chemically. Thereby the message, as received upon a strip of paper, is ready to be folded and sent to its destination; and the rapidity is equal to any automatic transmission. I accomplish this object by perforating the strip of paper used for transmitting with groups of holes, representing by each group a letter or character, the perforations being arranged to produce, as nearly as possible, the block or Roman letters or characters.

The transmission of the message by the line-wires may be in the usual manner, by a roller or stylus, and a line-wire to each row of perforations, so that, if there are five rows of perforations, there will be five stylus-points or rollers, each connected to a line-wire, and, at the receiving-instrument, there will be five pens or stylus-points near together, and the letter received will be in dots corresponding to the position of the perforations in the transmitting-paper, and, by their aggregation in groups, the letters will be clearly delineated, and formed almost as perfectly as printed characters, so that the strip of chemical paper can be delivered, and the rewriting or printing of the message dispensed with. The message, as received, being the counterpart of that transmitted, the perforated paper at the transmitting-station becomes a perfect record of the message, and the line can be worked up to its utmost capacity, because the paper can be perforated for transmitting about as rapidly as an ordinary printing-telegraph can be operated, and as many perforating operators and machines can be used as are necessary for the work that is to be done on the lines.

I have herein indicated the mode of using this improvement with five line-wires; but I contemplate to use the transmitting-paper, perforated as herein described, with transmitting and receiving mechanism that will operate with only one line-wire, and are to form the subject of a separate application.

In the drawing, Figure 1 represents a piece of paper with perforations, and adapted to use in transmitting. Fig. 2 shows the chemical paper with the same word printed thereupon by the dots running together, or being sufficiently close to each other to show the respective letters. Fig. 3 is a plan of a portion of the perforating-machine. Fig. 4 is an elevation endwise of the punches, and Fig. 5 is a partial section longitudinally.

I find that five lines of perforations are the most convenient for producing perforations in imitation of block letters or characters, and have shown and described such; but I am not limited in that respect.

Reference is hereby made to Letters Patent No. 121,601, granted to me December 5, 1871, for a machine for perforating paper for telegraphic purposes, which, with the modifications herein set forth, is adapted to punching the characters in the strip of transmitting-paper.

Instead of having two lines of punches, *i i*, as in aforesaid patent, these punches *i i* are twenty-five in number, positioned in a square of five each way, and as close together as convenient. Each punch is connected with its slide-plate *k*, and these slide-plates *k* are side

by side, and supported in the frame of the machine, so that they can be moved endwise with facility, and actuate the punches to which they are connected, respectively. The punches slide in the plate *m;* and *n* is the die-plate, as in said patent. There might be a spring to each slide-plate *k* and punch *i;* but I have shown a lever, *k'*, passing through mortises in the plates *k*, and provided with a spring to draw all the punches and slide-plates back to their normal position after they have been actuated.

If the punches are separate from the slide-plates, each row may be provided with a lever, *l*, and spring *o*, to return or draw back the punches; and said levers *l* act within notches in the punches, as shown.

The shoulders or projections 8 are provided upon the slide-plates *k*, contiguous to the respective pressers *e*, and these projections 8 are only upon such of the slide-plates that require to be moved by the presser to which they are adjacent, to operate the punches required to perforate the letter corresponding to the one on the finger-key *a* that is connected to the particular presser *e*, as in aforesaid patent; and I remark that the slide-bars *c* and connecting-cams *f*, or forks to move the pressers *e* by the finger-keys *a*, may be similar to those shown in said patent, and the lever *u'*, feeding-clamp *t*, pawl *u*, rack-bar *v*, and pawl 10 are similar to the parts shown, and they operate in the manner described in the aforesaid patent, and therefore do not require further description.

From the illustration given in Fig. 1, the general character of the groups of perforations will be apparent, and, in the square of twenty-five punches, the proper ones can easily be selected to perforate any given letter or character, sufficiently like block letters to be reliably read, at the receiving-station, on the chemical paper.

I am aware that types have been used in telegraphing characters, and also that letters have been made by punching slots and circular holes; but this mode of perforating could not be accomplished by one group of punches to perforate any letter by selecting punches from that group. Furthermore, the slots under the paper are liable to tear.

I claim as my invention—

1. A strip of telegraphic transmitting-paper perforated with holes of uniform size, grouped together to represent ordinary letters or figures, substantially as set forth.

2. The mechanism for making groups of perforations in a strip of paper in imitation of letters or characters, the same consisting of punches massed together in a square, or nearly so, and mechanism intervening between such punches and the finger-keys, for selecting from such mass of punches those that are required for perforating characters corresponding with the characters upon the respective finger-keys, substantially as set forth.

Signed by me this 25th day of August, A. D. 1873.

THOMAS A. EDISON.

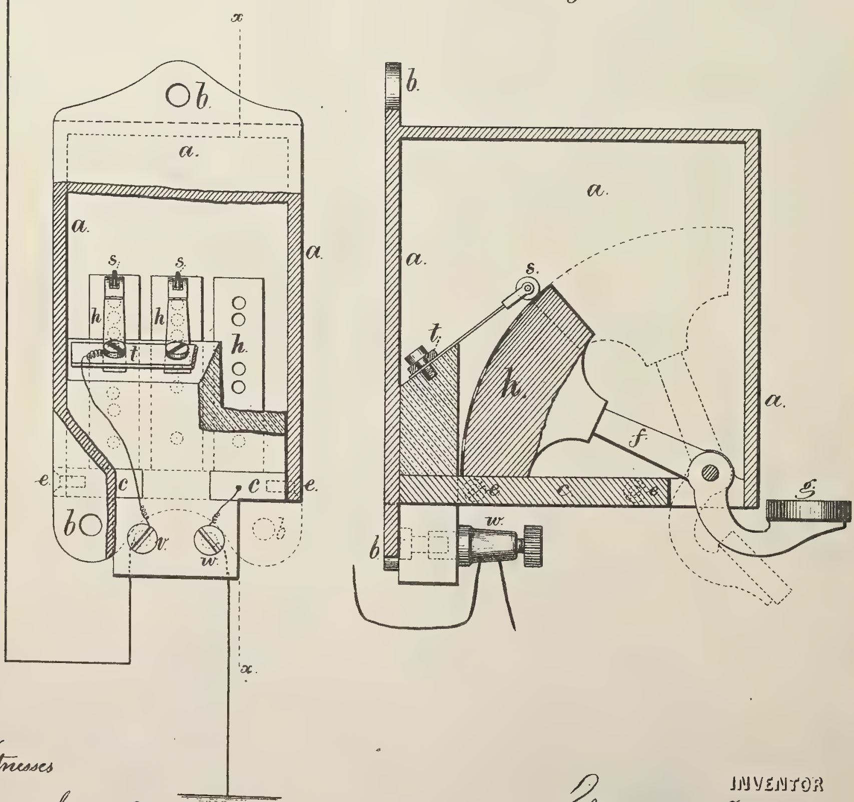
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

District Telegraph Signal-Boxes.

No. 154,788. Patented Sept. 8, 1874.

Fig. 1. Fig. 2.



Witnesses

Chas H. Smith

Geo. D. Walker.

INVENTOR

Thomas A. Edison.

per Lemuel W. Serrell

atty.

THE GRAPHIC CO. PHOTO-LITH 39 & 41 PARK PLACE, N.Y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN DISTRICT TELEGRAPH SIGNAL-BOXES.

Specification forming part of Letters Patent No. **154,788**, dated September 8, 1874; application filed May 11, 1874.

CASE 86.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, havented an Improvement in District Telegraphic Alarm and Signal Apparatus, of which the following is a specification:

Devices have heretofore been made in which a lever is depressed to send a telegraphic signal to a central office, and indicate a number that is allotted to the building sending the signal, and understood as a call for a "messenger," or another number by another lever for a call for "police" or for "fire." These devices are generally provided with electro-magnets, and are costly in construction and slow in operation, and contain a means for indicating whether the line is free. My improvement is made to simplify the construction of the signaling apparatus and render it very rapid in operation, so that a number of instruments can be safely connected in one circuit without risk of interfering with each other. The signals are received upon chemical paper.

I make use of an instrument which I term a "domestic telegraph;" it is in a branch circuit from the main line, and it contains two or more levers with circuit-closing segments, with alternate conducting and non-conducting material, so as to make and break the circuit in the branch and thereby give a signal at the central office, either by numbers or letters, the meaning of which is pre-arranged, so as to know the location from which the signal is sent and the meaning of that signal.

In the drawing, Figure 1 is a rear view of the instrument, with the case broken open to represent the interior parts; and Fig. 2 is a section at the line *x x*.

The case *a*, containing the operative parts, is, by preference, made of metal, and adapted to being screwed at *b* against a wall. The operative portions of the machine are upon the removable bottom *c*, hence they will be protected from injury or dust by the case, and can be taken out by removing the pins or screws that pass into the edges of the bottom, as seen at *e e*. Each lever *f* is made with a finger-piece, *g*, projecting outside the case, and a segment-head, *h*, that acts both as a weight to return the lever to place and a circuit-closer. The convex surface of the lever-segment is made with alternating conducting and non-conducting surfaces, to give the required pulsations. A convenient device for this purpose is a strip of paper, perforated at the required places, and attached to the surface of the metal. The contact-rollers *s* are at the ends of spring-arms and bear upon the circuit-segments *h*, and these spring-arms are connected together by the plate *t*, that is in metallic connection to the insulated binding-screw *v*, and the wire from this leads to the line, and the binding-screw *w* is in metallic connection with the plate *c* and levers *f*, and its wire leads to ground. The rollers *s s*, resting on insulating material in a normal position, the branch to the earth from the main line will remain broken, but as one of the levers is depressed and the segment thrown up into the position shown by dotted lines in Fig. 2, the circuit through the branch will be closed and pulsations sent, of the length and relative distance apart, according to the character of the conducting surface on the segment. These pulsations will be repeated in reverse as the lever falls, thus insuring accuracy by the repetition of the signal, and the entire signaling occupying such a small time—not more than two or three seconds—the risk of a simultaneous signal from some other instrument is so small as to require no attention.

I claim as my invention—

1. A signal apparatus, composed of a lever with a segmental circuit-closing surface, a contact-roller, a finger-key and connections, substantially as set forth.

2. A circuit-closing segment and a weight at the end of a lever, in combination with a circuit-closer and connections, substantially as set forth.

3. A telegraphic alarm and signaling apparatus, formed of two or more levers with circuit-closing surfaces contained within a box, with finger-pieces outside said box, substantially as specified.

Signed by me this 2d day of April, A. D. 1874.

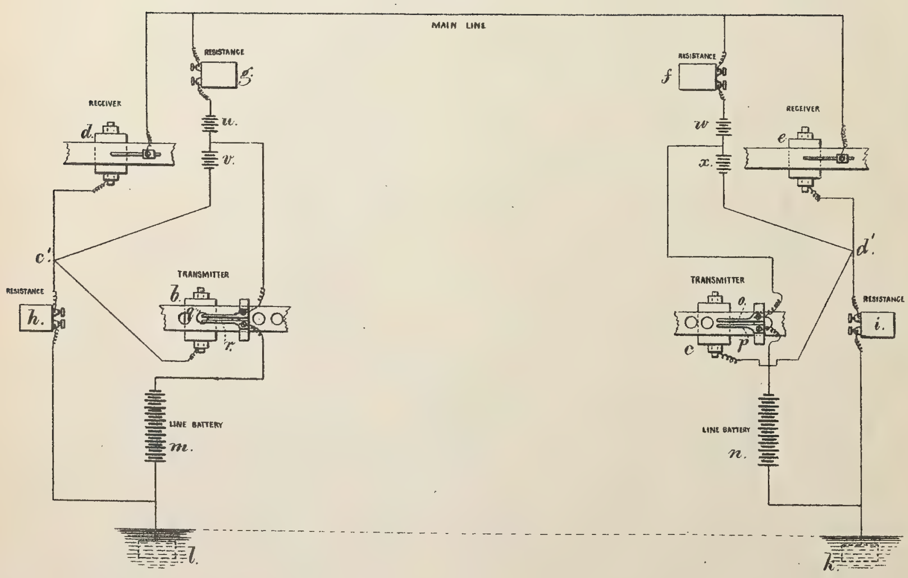
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
GEO. D. WALKER.

T. A. EDISON.

Duplex Chemical Telegraphs.

No. 156,843. Patented Nov. 17, 1874.



Witnesses,

Chas H Smith

Geo. D. Walker.

Inventor

Thomas A. Edison

L. W. Serrell

atty.

THE GRAPHIC CO. PHOTO-LITH. 39 & 41 PARK PLACE, N.Y.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN DUPLEX CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **156,843**, dated November 17, 1874; application filed March 13, 1873.

CASE 69.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Circuits for Chemical Telegraphs, of which the following is a specification:

The object of this invention is to transmit two dispatches over the same wire at the same time by telegraphs employing perforated transmitting-paper and chemical receiving-paper.

I make use of apparatus for transmitting by perforated paper, and receiving the messages on chemical paper at the respective ends of the line, and employ batteries, resistances, and connections arranged in such a manner that the effect of the transmitting-battery shall be neutralized upon the receiving-instrument at the same end by an equalization of tensions, and the receiver shall be at a point where the tension is equal to all the electric currents, except to that current which comes from the distant station.

In the diagram, *d e* are the receiving, and *b c* the transmitting, instruments. *m n* are the main batteries. *u* and *v* are two batteries in the shunt-circuit opposing each other, and producing no effect upon the receiver. *w x* are batteries operating similar to *u v*. *f g* are resistance-coils, to increase and decrease the length of the shunt-circuits. *h i* are resistance-coils of nearly the resistance of the line. *k l* are the ground-plates. *o p* are the double contact-springs, one spring, *o*, cutting off or "short-circuiting" the battery *x*, and the other spring, *p*, placing the main battery *n* upon the line. This main-battery current divides at *d′*, part going on the line and part to the ground, this route or negative of the battery through the resistance *i* being in fact an artificial line, it being well known that a battery will supply several lines with an undiminished quantity of electricity, and that the addition of a line decreases the total resistance of the battery's circuit, and produces an extra amount of electricity.

To obtain the transmission of two messages over the same wire at the same instant, it is only necessary that no effect shall be obtained upon the receiving-instrument by the putting on of the sending-battery at the same station.

I will now describe how I produce this effect: When the paper of the message to be transmitted intervenes between the contact-springs *q r* and the drum *b*, no current passes upon the line, and the batteries *u v*, being balanced within the shunt-circuit, produce no effect upon the receiver *d*, and a current coming from a distant station passes down the shunt, and also through the receiver *d*, and produces the message in the usual manner.

Supposing no current from the distant station was recording itself upon the receiver *d*, and it is desired to transmit a current to the distant station without producing any effect upon said receiver *d*, it is accomplished as follows:

When the contact-springs *q r* are in metallic contact with the drum *b*, by passing into a perforation in the paper being drawn over said drum, the current from the battery *m* passes by *r* over the line, but it splits in three directions at *c′*, part passing to the ground, and part passing by two routes to the line, via the shunt and the receiver *d*. The passage of the current through the receiver would give a large mark at the receiver were it not that at the same time that the contact-spring *r* placed the battery *m* upon the line the spring *q* short-circuited the battery *v*, which had been opposing the battery *u* in the shunt, hence allowing said battery *u* to have free action, and the current from this battery thus set free acts in a contrary direction through the receiving-instrument *d* to that of the battery *m*, and by means of a switch for putting in and out more or less cups the power of the batteries *m* and *u* are neutralized on the chemical paper at *d*; consequently no effect is produced at the receiver *d* when the battery *m* is placed on the line.

Of course, while the battery *m* is on, if a current from the battery *n* is sent over the line it records itself in the usual manner upon the chemical paper on *d*.

I claim as my invention—

The local batteries u and v or w and x in a shunt from the main line and opposing each other, and a connection between them to the transmitting or receiving instrument, in combination with the main batteries, resistances, and circuits, arranged substantially as and for the purposes set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

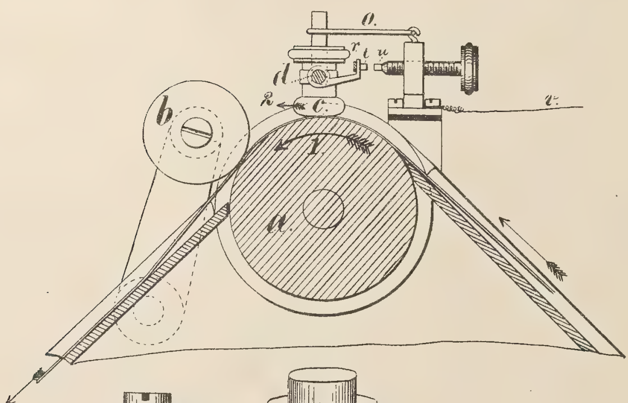
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Telegraph Apparatus.

No. 158,787. Patented Jan. 19, 1875.

Fig. 2.



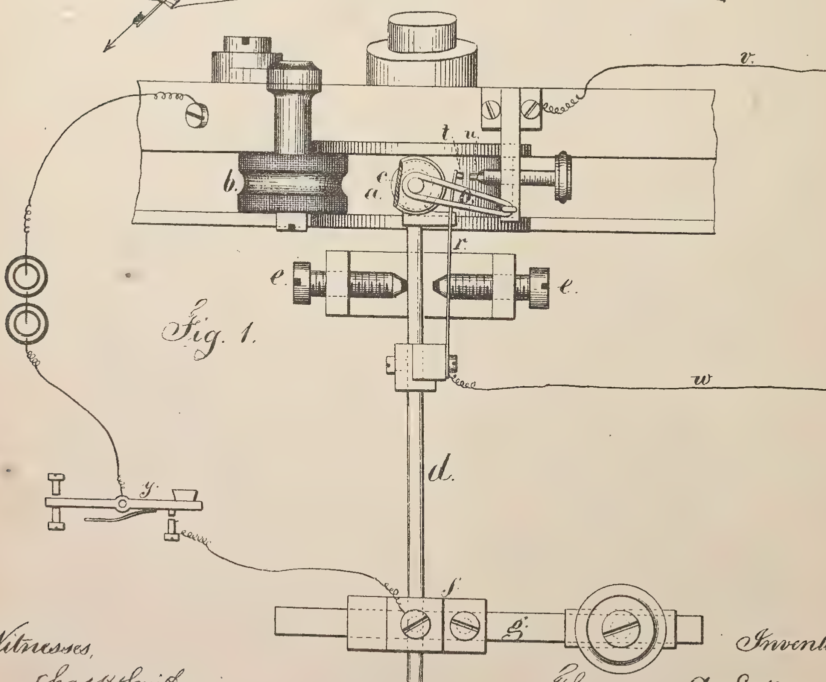


Fig. 1.

Witnesses,
Chas H Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty.

THE GRAPHIC CO. PHOTO-LITH 39 & 41 PARK PLACE N.Y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **158,787,** dated January 19, 1875; application filed August 13, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphs, of which the following is a specification:

In electric telegraphs motion has been obtained at a distance by a galvanometer and by an electro-magnet. Both of these are comparatively slow, and hence chemical decomposition has been resorted to for recording the characters sent from a distant station.

Heretofore there has been great difficulty in obtaining any means for repeating messages with high rates of speed, and magnets or galvanometers in an electric circuit always produce more or less disturbance by the secondary or induced current, and act to reduce the speed.

My invention is dependent on mechanical motion and electrical action, and responds to the most feeble currents when properly adjusted, and with very great rapidity; hence I term my invention the electric motograph.

The principles of its operation are that, when a moving surface is in contact with a slightly-yielding substance, the tendency is to move the latter by and with the former. If the circumstances of contact are varied the adhesion of the surfaces will be sufficient to cause the moving surface to move the yielding substance, or else to cause the yielding substance to slip more freely, and by its spring go in the opposite direction to the moving surface. I have discovered that the passage of electricity through the surfaces in contact will change the frictional adhesion, making it more or less according to the substances employed; and by balancing the mechanical forces so that when the surfaces in contact are not electrified the moving surface carries with it the yielding surface, and when electrified the yielding surface slips back over the moving surface, or vice versa, a mechanical movement is produced that is dependent on the electrical condition of the surfaces in contact; hence mechanical motion is obtained, first one way and then the other, that is as unlimited in its speed as the pulsations of electricity that pass, unobstructed by magnets or other hindrances, over the telegraphic lines.

In the drawing, Figure 1 is a plan of the apparatus, and Fig. 2 is a vertical section.

The drum *a* is revolved by clock-work or other suitable means; and *b* is a roller to press a strip of paper into contact with the drum *a*, so that said strip is drawn along with regularity; and *c* is the frictional presser and yielding vibrator. This vibrator is at the end of an arm, *d*, that allows it to yield, and the extent of motion should be limited by the adjusting-screws *e*. I prefer to make this arm serve the purpose of a spring, although separate springs might be used to regulate the pressure of the vibrator on the moving surface, and the force applied to draw the vibrator in the opposite direction to the movement given by the moving surface *a*, as illustrated by the rubber spring at *o*. The spring-arm *d* is upon the block *f*, that may be slid endwise upon the rod *g*, to regulate the power of the spring in moving the vibrator, and pressed down more or less to determine the friction between the vibrator and the moving surface.

If the surface of *a* is moving in the direction of the arrow 1 and the parts are properly adjusted, the friction will be sufficient to move the vibrator slightly in the direction of the arrow 2; but when the electric current passes through the surfaces of *a* and *i* the frictional contact will become less, so that the spring will overcome the friction and vibrate *c* in the other direction as the current is broken. The friction increasing, the vibrator moves the other way. If the surfaces in contact are of such a character that the frictional contact will be intensified by the electrical action, then the movements will be the reverse.

It will now be evident that the movement of the vibrator can be availed of for any electrical or telegraphic purpose.

By applying the spring *r* and circuit-closing points *t* and *u*, and insulating these parts, the local or relay circuit of which the wires *v* and *w* form parts will be opened and closed simultaneously, and in harmony with the key *y* or other transmitter in the circuit that passes through the vibrator *c* and drum *a*.

I do not limit myself to the use of any particular chemical substances, for water will, under some circumstances, answer for moistening the strip of paper or moving surface, or the moving surface may be of lead or other metal, and the surface of the vibrator be made of paper or other material, and moistened by preference.

In my experiments I have discovered that paper moistened with bromo chloralum and a lead vibrator connected to the positive pole increases the friction. I presume that the electric decomposition produces an effect similar to that resulting from the addition or removal of a lubricant, because, when the positive pole is connected with the vibrator the apparatus is not operative; hence the result named cannot proceed simply from the surfaces being electrified. Furthermore, the effect of relieving friction is most apparent at the commencement of the electric action; hence there may be a decomposition of the metallic oxide formed on the surface by the hydrogen evolved at the negative pole. With hydrate of potassa the resistance of the moistened paper to the passage of the current is but little, and excellent results are obtained.

My tests on different metals have shown that most all of the metals will operate to a greater or less extent with various solutions; but thallium and lead appear to be preferable, especially the latter, as acting with great delicacy where hydrogen is evolved by the decomposition; but I do not limit myself to any particular character of moving surface and vibrator so long as the characters of such surfaces are such that the frictional contact will be so changed when electrified as to cause or allow of the movement of the vibrator.

Paper moistened with alcohol, even absolute alcohol, will operate with a lead vibrator. With sulphate of quinine and hydrate of ammonia a platina vibrator will operate with either positive or negitive pole connected to the vibrator.

The motion of the vibrator may be made to record in ink dots and dashes by employing a small wheel inked by a fountain-wheel, and which is brought into contact with a moving strip of paper, or relieved therefrom by the movement of the vibrator.

I claim as my invention—

1. A moving surface in contact with a yielding vibrator, through which pulsations of electricity are passed when such surfaces in contact are of such a character that the friction will be varied by the electrical condition, substantially as set forth.

2. A vibrator, in combination with means for adjusting the pressure of the vibrator on the moving surface, and of the yielding force that moves the vibrator in the opposite direction to that derived from the moving surface, substantially as set forth.

3. The combination of a yielding vibrator, operated substantially as set forth, with a secondary circuit actuated by such vibrator, substantially as specified.

4. A telegraph instrument with a vibrator that is controlled by electro-chemical decomposition.

Signed by me this 7th day of August, A. D. 1874.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPH-PAPER.

Specification forming part of Letters Patent No. **160,402**, dated March 2, 1875; application filed June 1, 1874.

CASE NO. 78.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphic Paper, of which the following is a specification:

Ferrocyanide, or yellow prussiate of potash, has been employed in the solution for the chemical paper used in telegraphing. This solution is not as sensitive as my improved solution.

I make use of ferridcyanide of potassium, or red prussiate of potash in solution. This material may be prepared by using about one part of ferrocyanide of potash to sixteen parts of water, through which solution chlorine gas is passed until it assumes a greenish red tinge. The paper for the telegraphic receiving-instrument is to be immersed in this solution of ferridcyanide of potassium, and I prefer that chloride of calcium be added to the solution. An iron pen or stylus is used in the receiving-instrument.

I claim as my invention—

The solution for chemical telegraph-paper prepared with ferridcyanide of potassium, substantially as set forth.

Signed by me this 29th day of September, A. D. 1873.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPH-PAPER.

Specification forming part of Letters Patent No. **160,403**, dated March 2, 1875; application filed June 1, 1874.

CASE No. 84.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Paper for Receiving-Telegraph Instruments, of which the following is a specification:

I employ tannin and hydrosulphuret of ammonia in water, and prefer to add a small quantity of chloride of sodium to increase the conductivity of the parts.

The tannin may be an extract of nut-galls, but pyrogallic acid or tannic acid may be employed.

I find the tincture of nut-galls about one-half ounce, five drops of hydrosulphuret of ammonia, and a pint of water, filtered, form a very sensitive solution for moistening paper for a telegraphic receiving-instrument.

I claim as my invention—

The solution for chemical telegraph-paper prepared with tannin and hydrosulphuret of ammonia, substantially as set forth.

Signed by me this 29th day of October, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPH-PAPER.

Spec'fication forming part of Letters Patent No. **160,404**, dated March 2, 1875; application filed June 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Paper for Receiving-Telegraph Instruments, of which the following is a specification:

I make use of a tincture of logwood to moisten the paper. I find that with an iron pen a mark is made upon the paper when the current passes. There is no mark when the electric circuit is broken.

Logwood is peculiarly sensitive to color in the presence of iron, and the electric action develops the color.

I find it advantageous to use chloride of sodium in the solution of tincture of logwood to promote the conductivity of the paper, but muriate of ammonia is preferable for this purpose. By adding to the aforesaid solution of logwood a small quantity of sulphate of iron, the solution is of such a light color that the paper remains nearly white, and the mark will be produced by a platina pen or stilus, to which the negative pole is connected.

I claim as my invention—

The solution for chemical telegraph-paper, prepared with tincture of logwood, substantially as set forth.

Signed by me this 29th day of September, A. D. 1873.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Adjustable Electro-Magnet for Relays, &c.

No. 160,405. Patented March 2, 1875.

Fig. 1.

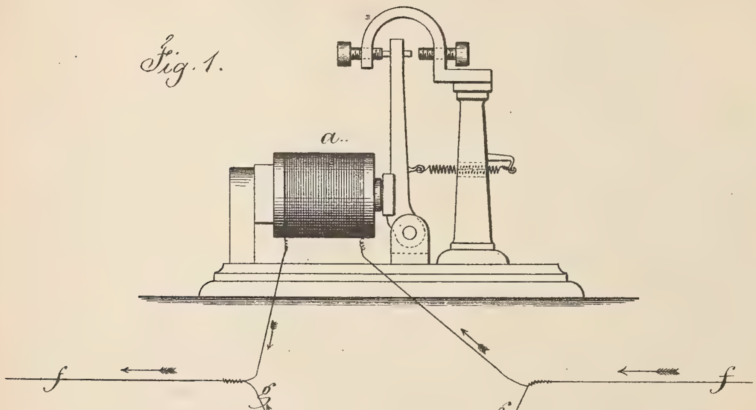
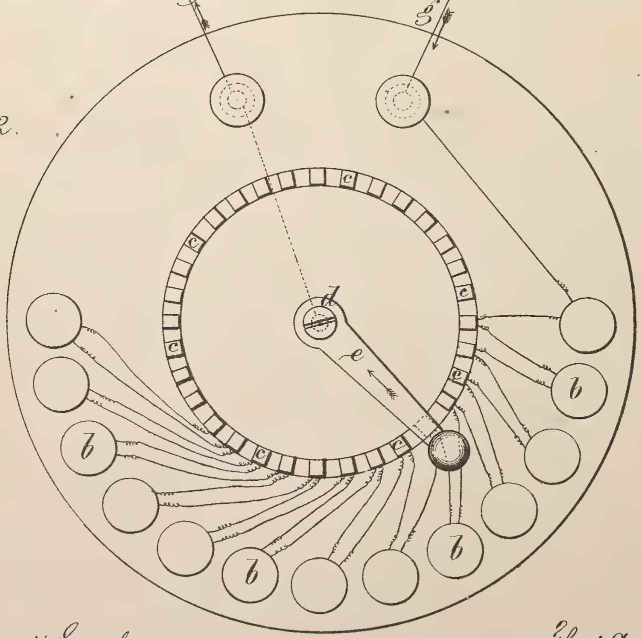


Fig. 2.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thos. A. Edison

Lemuel W. Serrell

att'y

THE GRAPHIC CO. PHOTO-LITH. 39 & 41 PARK PLACE, N.Y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN ADJUSTABLE ELECTRO-MAGNETS FOR RELAYS, &c.

Specification forming part of Letters Patent No. **160,405**, dated March 2, 1875; application filed July 29, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Adjusting Electro-Magnets, of which the following is a specification:

With an electro-magnet employed for a sounder or receiving-instrument it is very difficult to adjust the action, because the intensity of the current varies greatly, and frequently false currents reach the magnet and prevent its proper action. To provide for these various circumstances, it is usual either to vary the tension of the retractile spring, or adjust the position of the armature and core in relation to each other.

My invention is made with reference to obtaining a uniformity of current in the electro-magnet, and avoiding the adjustment of the magnet or the parts thereof. I make use of a shunt or branch circuit connected at both sides of the electro-magnet, and in that shunt I place a regulator composed of several helices or resistance-coils connected to each other and to circuit-pins, and employ an arm that can be revolved upon a center and bring into the shunt greater or less resistance, and thereby directing the proper proportion of the current through the electro-magnet and allowing the remainder to pass through the shunt.

In the drawing, Figure 1 is a side view of the electro-magnet, and Fig. 2 is a plan of the shunt-regulator.

The electro-magnet *a* is of ordinary character, and employed as a sounder or otherwise. The shunt-regulator contains the resistance-coils *b b*, connected to each other through the circuit-pins *c c* in the center of which is the pivot *d* of the arm *e*. The line *f* is connected through the magnet *a* and by the shunt-wires *g* with the pivot *d* and first coil *b*.

If the arm *e* is turned so as only to include one coil *b* in the shunt, the resistance will be but little, and most of the current will pass by the shunt and but little through the electro-magnet *a*, and by turning this arm *e* any desired number of coils *b* will be included in the shunt, so that, as the resistance increases, so the proportion of current directed through the magnet *a* will increase also.

I do not claim a rheostat or adjustable resistance in a shunt-circuit, to regulate the current passing through a chemical receiving-instrument. I do not claim a shunt around an electro-magnet with a resistance that is not variable and serves to lessen the injury to the contact-points.

I claim as my invention—

The variable resistance *b*, placed in a shunt-circuit, in combination with an electro-magnet for equalizing action of the current in the electro-magnet and dispensing with the spring-adjustment, as set forth.

Signed by me this 23d day of April, A. D. 1873.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPH-PAPER.

Specification forming part of Letters Patent No. **160,580**, dated March 9, 1875; application filed June 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Solutions for Chemical Telegraphic Paper, of which the following is a correct description:

I make use of about five pennyweights of aurichloride of sodium (double chloride of gold and sodium) to a pint of water, and about an ounce of nitrate of ammonia.

A small amount of bichloride of mercury increases the sensitiveness of the paper. This, however, may be omitted, and, in place of nitrate of ammonia, any other salt may be employed having a corresponding reaction with the aurichloride of sodium.

When an iron pen is used with the above solution, the mark on the paper is of a bluish tinge, and with a tin pen or stylus the mark is purple of cassius.

The above-mentioned solution is very sensitive to electric action, and is available in chemical telegraphs.

I claim as my invention—

The solution for chemical telegraph-paper prepared with aurichloride of sodium, substantially as set forth.

Signed by me this 14th day of October, 1873.

THOMAS A. EDISON.

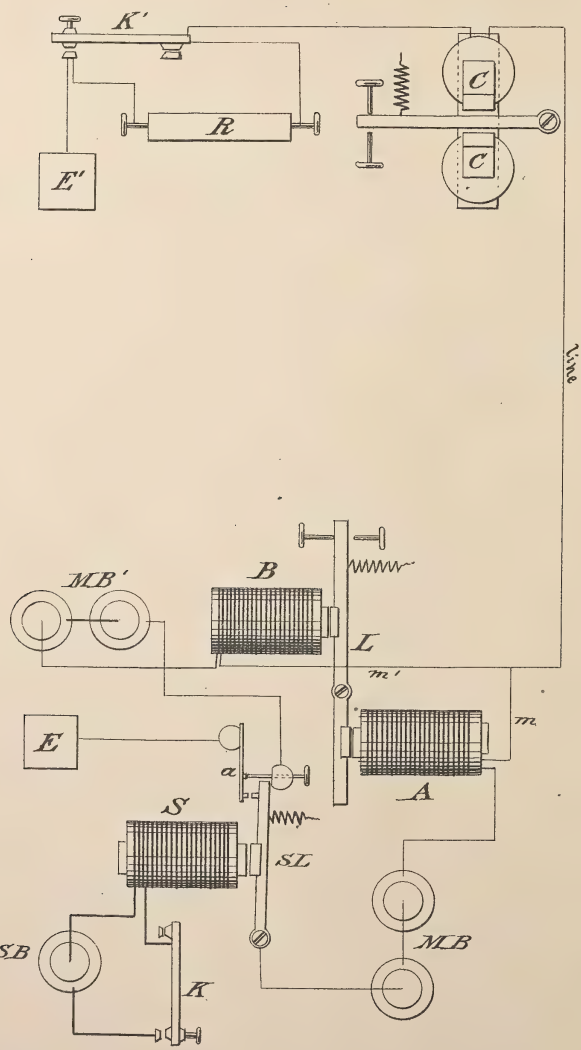
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Duplex Telegraph.

No. 162,633. Patented April 27, 1875.



Witnesses:

Chas Nida

C Sedgwick

Inventor:

T. A. Edison

Per

Munn & Co

Attorneys.

THE GRAPHIC CO. PHOTO-LITH. 39 & 41 PARK PLACE, N.Y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **162,633**, dated April 27, 1875; application filed April 26, 1873.

CASE H.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of the city of Newark, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in Duplex-Telegraph Apparatus, of which the following is a specification:

The invention has for its object the simultaneous transmission of two different dispatches or signals over the same line-wire from opposite directions, or in the same direction; and the invention consists in the transmission of positive and negative currents over the line to effect the reception of one message, and the increase and decrease of the strengths of these currents, either positive or negative, to effect the reception of the other message.

The accompanying drawings represent a plan view of my improved apparatus in this case, part of the apparatus being placed at one end of the line and part at the other end.

A and B are electro-magnets of equal strength, and are placed at an equal distance from and on the opposite sides of the armature-lever L, pivoted between them. Both magnets are arranged with separate batteries. The battery M B is connected with the magnet A, and with its positive pole to the line, and the battery M B′ is connected with the magnet B, and has its negative pole to the line. The batteries M B and M B′ are alternately placed into the circuit by the sounder-lever S L and the double-spring contact *a*, which is in contact with the earth. The key-lever S L is operated, as usual, by the local battery S B, key K, and magnet S. The magnets A and B are connected to the main-line wire and polarized relay C by the wires *m* and *m′*. The polarized relay C, being either at the same station or at the distant station, is operated by the positive and negative currents sent over the line. K′ is a Morse key, and R a resistance-coil or rheostat, connected to the key K and earth E.

The object of the key K′ and rheostat R is to increase and decrease the strength of the current upon the line, so as to affect the lever of the relay A B. The increase and decrease in the strength of the line-current do not affect the polarized relay C, as this is dependent for working upon the direction of the current or polarity, independent of its strength, so that signals may be transmitted by S L, batteries M B and M B′, or by any other battery-reversing device, and these currents, acting upon the relay C, cause its tongue to be thrown to the right or left, according to the polarity of the current transmitted. At the same time another set of signals may be sent over the same wire by the depression of the key K′, which causes a decrease in the resistance of the line, and a consequent increase in the strength of the current on the line, and this increased strength of current produces sufficient magnetism in either A or B to overcome the attraction of its spring, and it is drawn toward the magnets.

On closing the key K the magnet attracts the lever S L, throwing the battery M B′ and magnet B out of circuit, and the magnet B and battery M B, with its positive pole, is placed in circuit and toward the line. In a like manner, when the key-lever is not attracted by its magnet, the magnet A and battery M B is thrown out of circuit, and the magnet B and battery M B′, with its negative pole toward the line, is thrown in circuit, the armature-lever L remaining constantly attracted (if K′ be closed) by either A or B, as the instantaneous transfer of polarity permits no separation of the same.

If both positive and negative currents were passed through one magnet only, a charge and discharge would be produced with a change of polarity in the iron cores, and the armature would be drawn away from the cores of the magnet for an instant by its retractile spring, at the moment when the cores were changing their polarity. In this arrangement the wires upon the magnets, connections, and arrangement of batteries are such that the polarity of both magnets are never changed.

The polarized relay is self-adjustable, and follows the positive and negative currents, whether the tension of the same is suddenly increased or decreased.

The polarized relay C can be placed at a number of stations on the line, and each will

be able to receive the signals from the stations, transmitting positive and negative currents. The relay A B may also be placed at a number of stations, if A or B be dispensed with, and other devices applied to prevent the mutilation of the signals by change in the polarity of its iron core.

I claim as new and desire to secure by Letters Patent—

1. The armature-lever L, pivoted between the magnets A and B, and operated by an increase and decrease in the tension of the line-current. in combination with the key K′ and rheostat R, for the purpose set forth.

2. The sounder-lever S L, double-spring contact *a*, and batteries M B and M B′, arranged substantially as set forth, and for the purpose specified.

3. The combination, with the main-line circuit, of a receiving-instrument operated by changes in the polarity of the current independently of tension, with another receiving-instrument operated by changes of tension independent of polarity, means of changing the polarity of the current, and means of changing the tension of the current, substantially as and for the purpose specified.

THOMAS A. EDISON.

Witnesses:
PAUL GOEPEL,
T. B. MOSHER.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CHEMICAL TELEGRAPHY.

Specification forming part of Letters Patent No. **166,859**, dated August 17, 1875; application filed July 25, 1874.

CASE No. 88.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphs, of which the following is a specification:

The object of this invention is to record dots and dashes upon chemically-prepared paper by electric decomposition for telegraphing.

The invention consists in forming the decomposing stylus or pen of tellurium and wetting the paper with water or any liquid conductor. I prefer water to which has been added a quantity of hydrate lime or potash.

If the stylus, tipped with tellurium, is connected to the zinc end of a battery, and the drum or plate upon which the moistened paper rests be connected to the copper end of the battery, hydrogen is evolved at the point where the tellurium touches the paper. The hydrogen combines with the tellurium to form hydrotelluric acid, which has a red color, but is instantly decomposed in contact with the air, and forms a black pigment, which is permanent. I have found that this reaction is more delicate than that of iodide of potassium, which is the most delicate known in chemistry. This decomposition of tellurium has the peculiar characteristic over all other metals that it produces the mark with hydrogen, and also that the mark, at its first formation, is not a precipitate like the ferrocyanide of iron when an iron pen and ferrocyanide of potassium are used, which has a tendency to adhere to the stylus after the current has ceased, and produce attenuation of the signals; but the permanent color is formed by the action of the air after the decomposition has taken place: hence the signals will be much sharper.

I claim as my invention—

1. The method of recording telegraph or other signals by the electro-decomposition upon moistened paper or other material of a stylus of tellurium.

2. A paper moistened with hydrates of lime, potash, or the cyanides of potassium, for use with a tellurium stylus, for the purpose set forth.

Signed by me this 1st day of June, A. D. 1874.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CHEMICAL TELEGRAPHY.

Specification forming part of Letters Patent No. **166,860**, dated August 17, 1875; application filed July 25, 1874.

CASE No. 89.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphs, of which the following is a specification:

The object of this invention is to record dots and dashes upon chemically-prepared paper by electro-decomposition for telegraphic purposes.

The invention consists in combining the sesquichloride of iron with the ferrocyanide of potassium, and using a stylus of tin, which is connected to the copper pole of the battery.

The action is as follows: Nascent oxygen evolved at the point of the tin stylus combines with the stylus to form the protoxide of tin, which is a powerful reducing agent. This reduces the sesquisalt of iron to a protosalt of iron, and the ferrocyanide of potassium combines to form a precipitate of Prussian blue. The reaction is very delicate. Chloride of ammonium or sodium increases the delicacy.

I claim as my invention—

The combination of a sesquisalt of iron with the ferrocyanide of potassium, and a tin stylus, for the purpose set forth.

Signed by me this 1st day of June, A. D. 1874.

THOS. E. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CHEMICAL TELEGRAPHY.

Specification forming part of Letters Patent No. **166,861**, dated August 17, 1875; application filed July 25, 1874.

CASE No. 90.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphs, of which the following is a specification:

The object of this invention is to record dots and dashes upon chemically-prepared paper by electro-decomposition for telegraphic purposes.

The invention consists in combining a protosalt of iron with the sulpho-cyanide of potassium, in which the paper is to be moistened. The recording-stylus is formed of platinum, or metal that is not oxidized by the nascent oxygen.

The action is as follows: When the copper end of a galvanic battery is connected to the platina stylus, resting on the paper that is moistened in the above solution, and the zinc end is connected to the metal upon which it rests, oxygen is evolved at the platina point. This raises the protoxide to a sesquioxide or peroxide, when the sulpho-cyanide of potassium, which has no action on a protosalt of iron, combines with the higher oxide to form the blood-red sulpho-cyanide of iron.

The reaction is very delicate. I prefer to use the protosalt of iron in the form of the protosulphate of iron. Chloride of sodium added to the solution increases the delicacy.

I claim as my invention—

The combination of a protosalt of iron, sulpho-cyanide of potassium, and a non-oxidizable stylus, for the purposes set forth.

Signed by me this 1st day of June, A. D. 1874.

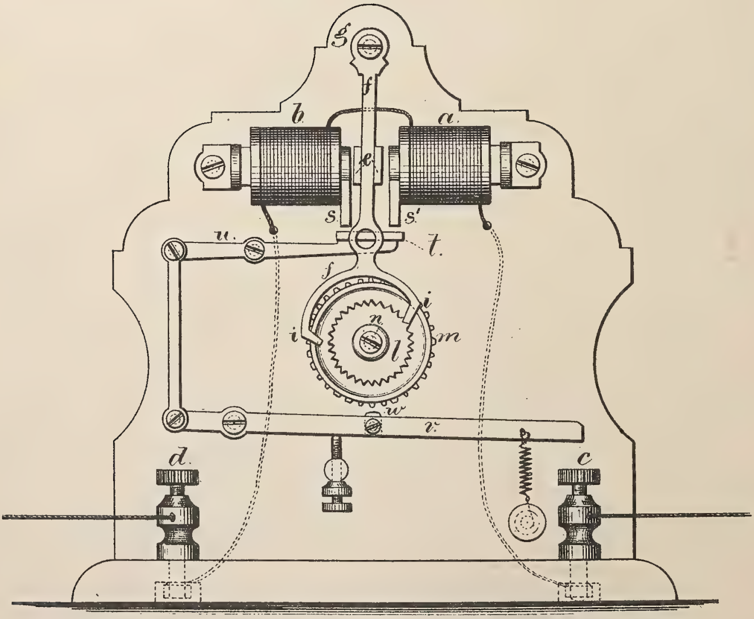
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Printing-Telegraph.

No. 168,004. Patented Sept. 21, 1875.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thos A. Edison.

per Lemuel W. Serrell

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **168,004**, dated September 21, 1875; application filed June 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, of which the following is a specification:

Two electro-magnets operating upon an armature have been used, and the magnets have been charged with pulsations of alternate opposite polarity, and the armature has acted to move the type-wheel.

My present invention relates to this class of printing-telegraphs; and consists in an arrangement of armatures, electro-magnets, type-wheel, and printing-lever, so that the printing is effected by the same magnets that set the type-wheel when a pause occurs in transmitting currents of alternate opposite polarity.

In the drawing I have represented, by an elevation, the instrument as arranged by me.

The electro-magnets *a b* are in the main-line circuits that connect with the binding-screws *c d*, and between the cores of these magnets is the armature *e*, that is by preference made double, and upon opposite sides of the lever *f* that has its fulcrum at *g*, and is provided with wedge-acting pallets *i i*, operating upon the ratchet-wheel *l*, shaft *n*, and type-wheel *m* to rotate the same. The cores of the electro-magnets are extended laterally, as at *s s′*, and an armature, *t*, is provided upon the lever *u*, that is connected with the printing-lever *v*. The pulsations sent over the line are of alternate opposite polarity, so that the armature *e* will be repelled from the magnet, with which it is in contact, as the current of opposite polarity enters the helix, and the armature and lever by their momentum (from repulsion) are thrown toward the opposite magnet, and the armature is attracted thereby. In this manner the type-wheel pallets will be moved with as great rapidity as the pulsations of alternating polarity can be sent. The armature *t*, however, will not be attracted because the magnetic energy of one polarity does not accumulate sufficiently before the pulsation of opposite polarity is introduced; but when a slight pause occurs on a closed circuit the armature *t* is attracted, and the printing-lever is moved, and the impression made by the pad *w*, pressing the paper toward the type-wheel.

The mechanism for moving the paper forms no part of my invention, and may be of any desired character.

I claim as my invention—

1. Two electro-magnets in the electric circuit, with an armature moved between their cores in consequence of reversing the polarity of the pulsations, such armature actuating the lever and type-wheel, in combination with the lateral cores of the electro-magnet and the armature that operates the printing-lever, as set forth.

2. The arrangement of the type-wheel lever and armature between two electro-magnets, and an armature and lever at one side of the type-wheel, operating an impression-pad at the opposite side of the type-wheel, substantially as set forth.

Signed by me this 22d day of May, A. D. 1874.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **168,465**, dated October 5, 1875; application filed January 15, 1875.

CASE 102.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphic Solutions, of which the following is a specification:

I have found that if a colored salt of aniline, preferably rosaniline, known in commerce as magenta, which dissolves in water to a deep red, be treated with nitric acid, or, preferably, red fuming nitrous acid, it is oxidized to a nearly colorless solution. If a piece of paper is moistened in this solution and used in a chemical-telegraph recording-instrument, beautiful red marks are obtained when the positive pole of the battery is connected to the decomposing-pen, which is preferably of tin. The nascent oxygen in electrolysis combines with the tin pen to form protoxide of tin, which is a powerful reducing agent, and the colorless compound of oxidized rosaniline is decomposed, leaving it in its original state, viz., deep red. By the action of the air these marks soon become more apparent and of a deep violet. It is a very sensitive reaction, being as delicate as the iodide-of-potassium solution, but with the advantage of permanent marks and economy.

If an easily-decomposed chloride of any metal be added, the delicacy of the reaction is greatly increased, as the nascent chlorine, combining with the tin to form a protochloride, is a more powerful reducing agent than the protoxide. The delicacy of the reaction is still further increased by adding an organic acid, preferably oxalic.

A great number of the salts or compounds of aniline may be rendered colorless by oxidation and reduced to their original state, as set forth; but I prefer magenta, or rosaniline, on account of its superior coloring properties.

I claim as my invention—

A chemical solution for telegraphic paper containing aniline in a colorless, or nearly colorless, condition, substantially as set forth, in order that the mark may be made by electrolysis, as specified.

Signed by me this 14th day of August, A. D. 1875.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **168,466**, dated October 5, 1875; application filed January 26, 1875.

CASE 106.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Preparing Paper for Chemical Telegraphs, of which the following is a specification:

I have found that if a protosalt of iron be combined with vegetable astringents, such as tannin or its derivatives, gallic or pyrogallic acid, scarcely any coloration follows; but if a piece of paper be moistened with this solution and placed under the recording-point, the nascent oxygen due to electrolysis raises the protosalt of iron to a higher oxide, with which the vegetable astringents combine to form intense inky compounds. The addition of nitrate of ammonia, or any salt which does not precipitate, increases the delicacy of the reaction, by reducing the resistance of the paper. The addition of a vegetable acid, such as oxalic acid, also increases the delicacy. I prefer to use a platina decomposing-point. It does not matter what the proportions of the various substances are as long as they are in excess of that necessary to produce the full amount of reaction. I prefer to use protochloride of iron, pyrogallic acid, nitrate of ammonia, and oxalic acid.

I claim—

In a chemical solution for telegraphic paper, the combination of a protosalt of iron with a vegetable astringent and a conducting salt, substantially as set forth, in order that the mark may be made by electrolysis, as set forth.

Signed by me this 18th day of January, A. D. 1875.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN RECORDING-POINTS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **168,467**, dated October 5, 1875; application filed January 26, 1875.

CASE 105.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Recording-Points for Chemical Telegraphs, of which the following is a specification:

I have found that if the decomposing and recording point of a chemical telegraph be made of metallic ruthinium, and connected to the positive pole of the battery, a coloration is made upon nearly dry paper, which had been moistened with various chemical solutions, preferably ferro-cyanide of potassium and chloride of sodium. The reaction is of extreme delicacy, the marks being due probably to the finely-divided oxide of ruthinium formed by the electrolytic oxygen.

I claim—

A recording-point formed of metallic ruthinium in a chemical telegraph, substantially as set forth.

Signed by me this 18th day of January, A. D. 1875.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Transmitter and Receiver for Automatic Telegraphs.

No. 168,242. Patented Sept. 28, 1875.

Fig. 1.

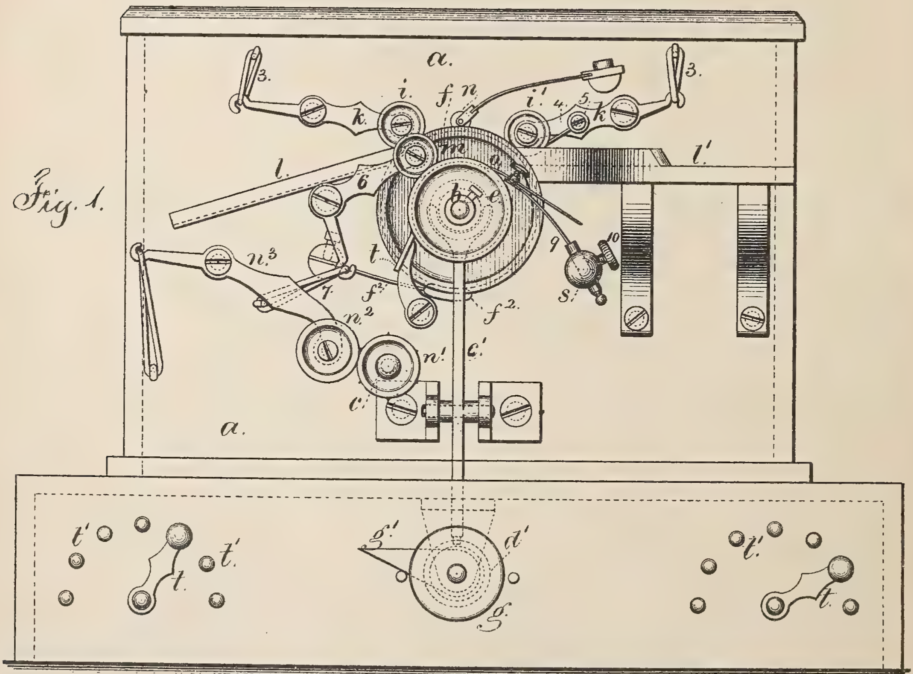
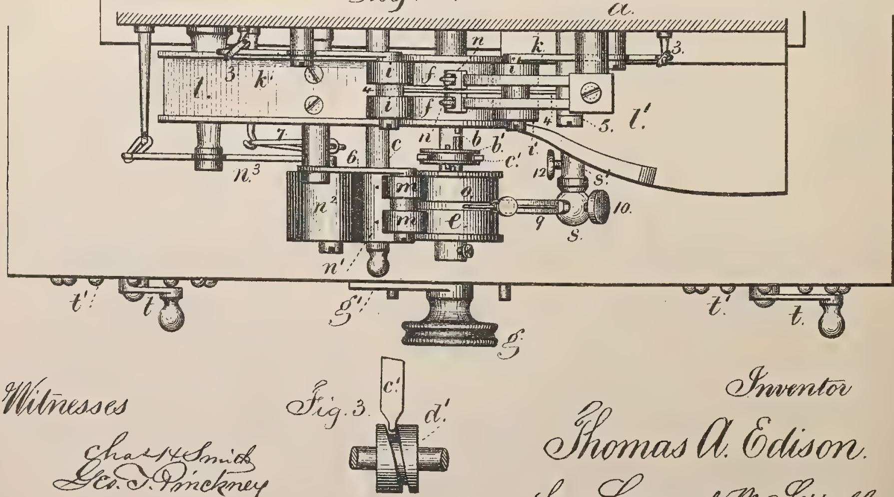
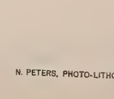


Fig. 2.



Witnesses

Fig. 3.



Chas. H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison.

for Lemuel W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN TRANSMITTERS AND RECEIVERS FOR AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **168,242**, dated September 28, 1875; application filed January 26, 1875.

CASE 104.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic-Telegraph Instruments, of which the following is a specification:

This instrument is made for drawing through perforated paper and transmitting pulsations, or for moving the chemical prepared strip of paper, and winding the same up ready for transfer to the copyist to write out or print the message. My improvement has special reference to the mechanism by means of which these operations of transmitting and receiving are performed in one instrument.

In the drawing, Figure 1 is an elevation of said instrument, and Fig. 2 is a plan of the same.

Within the box *a* there is to be placed any suitable clock movement or mechanism, operated by a weight or spring to propel the shafts *b* and *c* with the required velocity. This clockwork is not shown in the drawings, as it may be of any convenient character, and it should include stopping and starting mechanism. The drums *e* and *f* are loose upon the shaft *b*, but there is between them a coupling, *b'*, sliding upon a feather or key, and connecting either *e* or *f* to the shaft *b*, so that it will be revolved by and with such shaft; and this coupling is operated by a lever, *c'*, at the lower end of which is a finger passing into the screw-cam *d'*, (shown detached in Fig. 3,) that is connected with the button *g* and pointer *g'*, so that by turning such button the drum *e*, for chemical paper, will be connected to the shaft and revolved, or the drum *f*, for perforated paper. The spring friction-brake *f'* holds the drum *f* from turning when the paper is not to be run through, and this brake also serves to keep the surface of the drum clean. The contact-rollers *i* and *i'* serve to press the perforated paper to the drum *f*, so that it may be drawn through by the revolution of said drum. These rollers are on levers *k*, that are acted upon by springs 3, and there is a guide-wire, 4, that extends from a stud, 5, on *k*, beneath the rollers *i i'*, and these rollers are grooved for its passage, and this wire serves to direct the advancing end of the strip of paper to the roller *i*. The troughs *l l'*, at opposite sides of the drum *f*, serve to guide the paper as it is entered and passes away, and the rollers *n* upon spring-arm close contact through the holes in the strip to transmit the pulsations, as heretofore usual. The strip of chemical paper is passed beneath the stylus *o*, over the drum *e*, beneath the contact-roller *m*, and is wound upon the roller n^1. The contact-roller *m* is upon an arm or lever, 6, that is provided with a spring, 7, and the stylus *o* is upon a spring-arm, 9, that is made with a stock that can be moved in a small head, *s*, and clamped by a screw, 10, so as to be adjusted lengthwise, and this head *s* has a stem running into the horizontal column *s'*, and clamped by the screw 12, to regulate the pressure of the stylus upon the paper. The cleaning-plate *t*, having a tongue passing into a groove in the drum *e*, prevents the paper sticking to the said drum. This has heretofore been used, and the end of the strip, coming into contact with the roller n^1, is pressed to the same by the roller n^2 and spring-lever n^3, and said paper is caused to adhere to the roller n^1 by small points that are upon its surface; hence the paper will be carried around and wound upon this roller n^1, and the roller n^2 will yield as the roll of paper increases in size. As heretofore explained, the shaft *c*, upon which this roller n^1 is placed, is revolved by the clock-work, so that it will act to wind up the paper; but as the roll increases in diameter the speed of winding would increase. This, however, is allowed for by friction between the surface of the shaft *c* and the interior of the central hole of said roller n^1, as the roller is simply placed upon this shaft; and this construction allows the roller to be removed with the paper upon it when the message is finished, or the paper has accumulated in a roll of sufficient size. This removable roller and its paper are taken by the person who writes out or prints the message from the chemically-marked strip.

The transmitting-roller being larger than the receiving-roller, and both making the same

number of revolutions, the perforated paper will be moved more rapidly than the chemical paper, so that the marks on the chemical paper will be contracted proportionately, and the length of the chemical paper lessened to the proper extent.

The circuit-connections to the instrument are to be of any desired character. It is generally preferable to connect the stylus *o* and the rollers *n* with the line and the instrument to the earth, and to throw back either the stylus or the rollers that are not in use.

The switches *t* and pins *t′* serve to place upon the line greater or less resisting power under arrangements of circuits adapted to automatic telegraphy.

I claim as my invention—

1. The transmitting-drum *f* and receiving-drum *e* upon the same shaft, in combination with the receiving and transmitting stylus or rollers *n o* and a clutch, *b′*, for connecting either one drum or the other to the shaft *b*, as set forth.

2. The two contact-rollers *i* and *i′*, applied to the transmitting-drum, one at each side of the roller *n* or stylus, in combination with the wire 4, to guide the advancing end of the strip of paper, as set forth.

3. The roller n^1, removable from the shaft *c*, and revolved by friction, and containing points, in combination with the receiving-drum *e* and yielding roller n^2, substantially as set forth.

Signed by me this 18th day of January, A. D. 1875.

THOS. A. EDISON.

Witnesses:

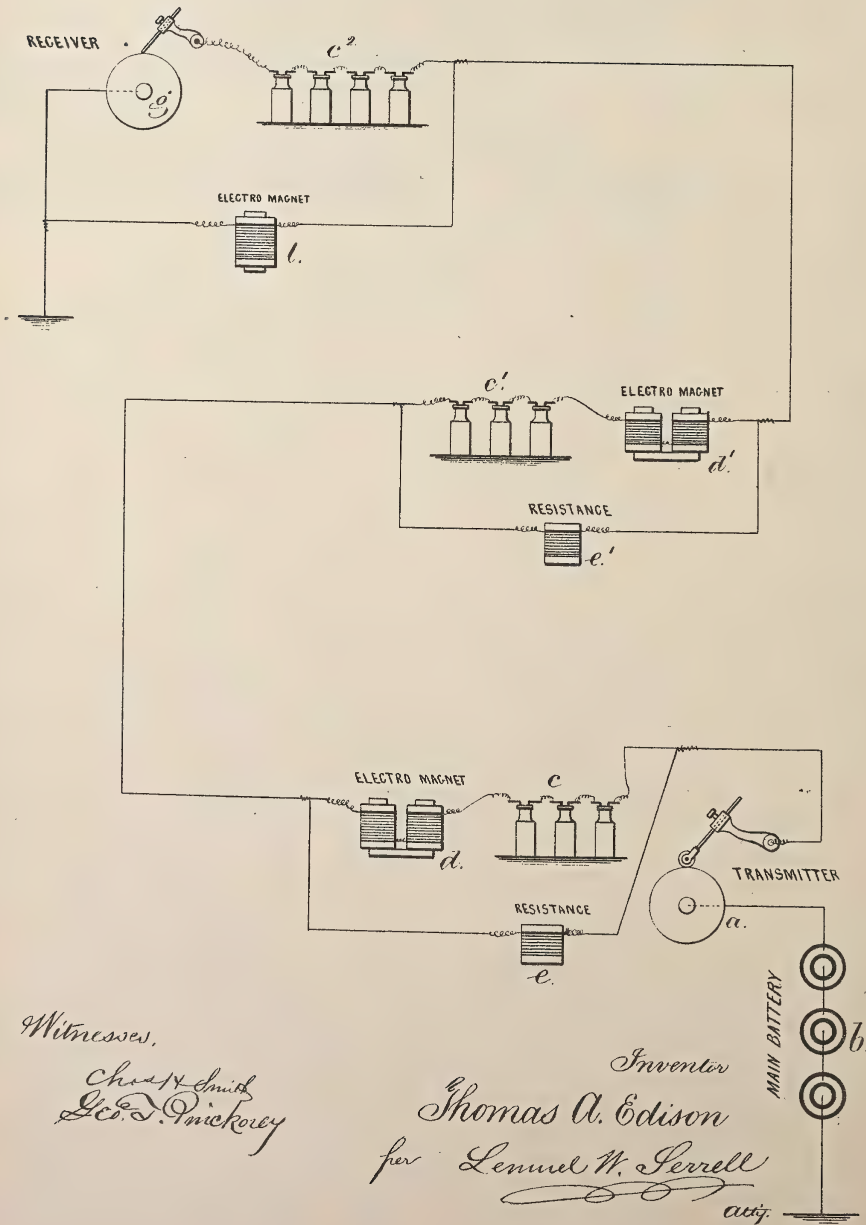
GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Automatic Telegraph.

No. 168,243. Patented Sept. 28, 1875.



Witnesses,

Chas. H. Smith

Geo. T. Pinckney

Inventor

Thomas A. Edison

per Lemuel W. Serrell

att'y.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **168,243**, dated September 28, 1875; application filed January 26, 1875.

CASE 103.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphs, of which the following is a specification:

The object of this invention is to obtain more powerful action at the chemical receiving-instruments, and to obtain a more powerful compensation for the static currents of the line, and also to neutralize the reactionary or secondary currents from electro-magnets introduced in the line.

It is well known that when a secondary battery, made of cells containing acidulated water and two metals of the same character, is introduced into a main circuit, the secondary battery sets up a current in the same direction as a current passing through that secondary battery from the main battery, thus intensifying the pulsations on the line; and that when the circuit to the main battery is broken, the secondary battery sets up a current in the opposite direction. The action of an electro-magnet is the reverse, as such electro-magnet sets up a current opposed to the main current when the circuit is closed, and in the same direction when the circuit is interrupted or broken.

I make use of an electro-magnet contiguous to the chemical receiving-instrument, for compensating or neutralizing the static discharge of the line, as set forth in my Patent No. 135,531, and I employ the secondary battery aforesaid in addition, to insure more distinct pulsations at the receiving-instrument. With signaling electro-magnets or sounders placed in the main line, I use the said secondary batteries to neutralize the effects of such electro-magnets in the line when they discharge.

In the diagram, the transmitter *a* is shown for perforated paper; but it may be of any desired character. The main battery *b* is connected with the earth and transmitter. The secondary battery *c*, of acidulated water in cells, also containing similar metallic poles, is placed in the main line. *d* is an electro-magnet, which may be of a relay or sounder, and *e* is a resistance, which should be an adjustable rheostat in a shunt around the receiving-instrument and secondary battery. These parts are duplicated at c^1, d', and e', and it is to be understood that they may be used at any number of intermediate stations. In each instance the secondary battery augments the power of the pulsation sent from the main battery sufficiently to make up for the resistance of the magnets or line.

The rheostat *e* or e' causes the proper proportion of current to pass through *c d*, and as the electro-magnet discharges, upon breaking the main circuit, a path is provided for the same in the local circuit, so that it will not pass out upon the line and interfere with or mutilate the signals, and the discharge of the secondary battery neutralizes the static charge of the line and the discharge of the electro-magnet by opposing the same.

By this arrangement intermediate relays and sounders can be introduced without interfering with the rapid pulsations on the main line.

At the chemical receiving-instrument *g* the secondary battery c^2 is used to intensify the pulsation on the main line, and produce a distinct mark, and also, by its discharge, to neutralize the static discharge from the line; and the electro-magnet *l* is introduced in a branch around the receiving-instrument to set up a secondary or reactionary current, to aid in neutralizing the static discharge from the line, as in aforesaid patent.

This magnet also serves as a resistance to direct a portion of the current through the chemical paper.

I claim as my invention—

1. The secondary battery, with poles of similar materials, applied in the main circuit, containing the receiving-instrument, in combination with a shunt around the receiving-instrument, containing a resistance or electro-magnet, for the purposes set forth.

2. The combination, with the signaling electro-magnet, placed in the line, of a secondary battery, also in the line, and a shunt around such instrument, containing a resistance, substantially as set forth.

Signed by me this 18th day of January, A. D. 1875.

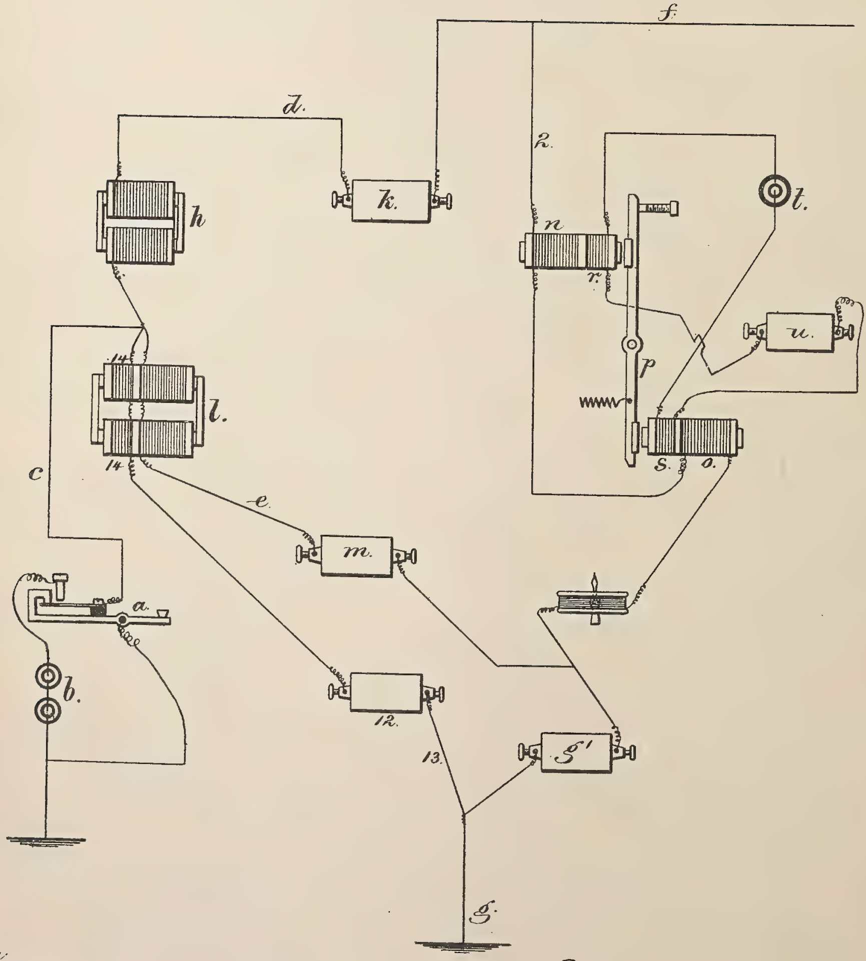
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Duplex Telegraph.

No. 168,385. Patented Oct. 5, 1875.



Witnesses

Chas. H. Smith

Geo. T. Pinckney

Thomas A. Edison

per Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **168,385**, dated October 5, 1875; application filed January 26, 1875.

CASE 111.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

The object of this invention is to more perfectly balance and neutralize the static discharge of the line, so that there will not be any false pulsations.

In the accompanying diagram the pulsation is given at the sending-station by the circuit-preserving key *a*, battery *b*, and connections *c* to the bridge-wires *d e* between the line *f* and earth *g*. In the portion *d* of the bridge is the electro-magnet *h* and rheostat *k*, and in the portion *e* is the electro-magnet *l* and rheostat *m*, and the receiving-instrument is placed in the circuit 2 between the two portions *d e* of the bridge. Said receiving-instrument is made of two electro-magnets, *n o*, that are placed at opposite sides and ends of the armature-lever *p*, so as to act thereon in unison with each other, and the cores of these electro-magnets are extended and surrounded with the additional helices *r* and *s*, that are in a local circuit from the battery *t*, and provided with a rheostat, *u*, the object of this being to set up a sufficient magnetizing power in the helices of the local circuit to neutralize in the cores the magnetism that may result from permanent currents upon the line, thereby balancing such currents, and leaving the receiving-instrument free to respond to the pulsation from the distant instrument. This local circuit and helices also serve to neutralize any residual magnetism in the cores. This arrangement of electro-magnets and helices in a local circuit is not herein claimed, and it is set forth in a previous application made by me.

The electro-magnets *h l* set up in the triangular or bridge circuit *d e* 2 a secondary current when the circuit from *b* is broken, so as to neutralize the static discharge from the line *f* and artificial line *g g'*.

In consequence of the differences of condition between the actual line *f* and the artificial line *g g'*, it is difficult to adjust the rheostats *k m g'* so as to perfectly neutralize the static discharges, and equalize their action in the bridge *d e*, so that the receiving-instrument will be at a neutral point. To facilitate this operation we make use of a second artificial line, formed of a rheostat, 12, earth-connection 13, and helices 14, around the cores of the electro-magnet *l*, so that, the pulsation from *c* dividing, a portion goes through 14, 12, and 13, as well as through *h* and *l*, the result of which is that the cores of *l* are more highly energized than of *h*, and the reactionary or secondary current set up in *e* by *l* is increased to whatever extent may be required to equal the static discharge from the line circulating through *d* and the receiving-instrument.

I claim as my invention—

The electro-magnets *h* and *l*, placed in the bridge-circuit between the sending-instrument and the line and artificial lines, respectively, in combination with the second artificial line 12 13 and the helices 14 around the cores of the electro magnet *l*, for the purposes set forth.

Signed by me this 18th day of January, A. D. 1875.

THOS. A. EDISON.

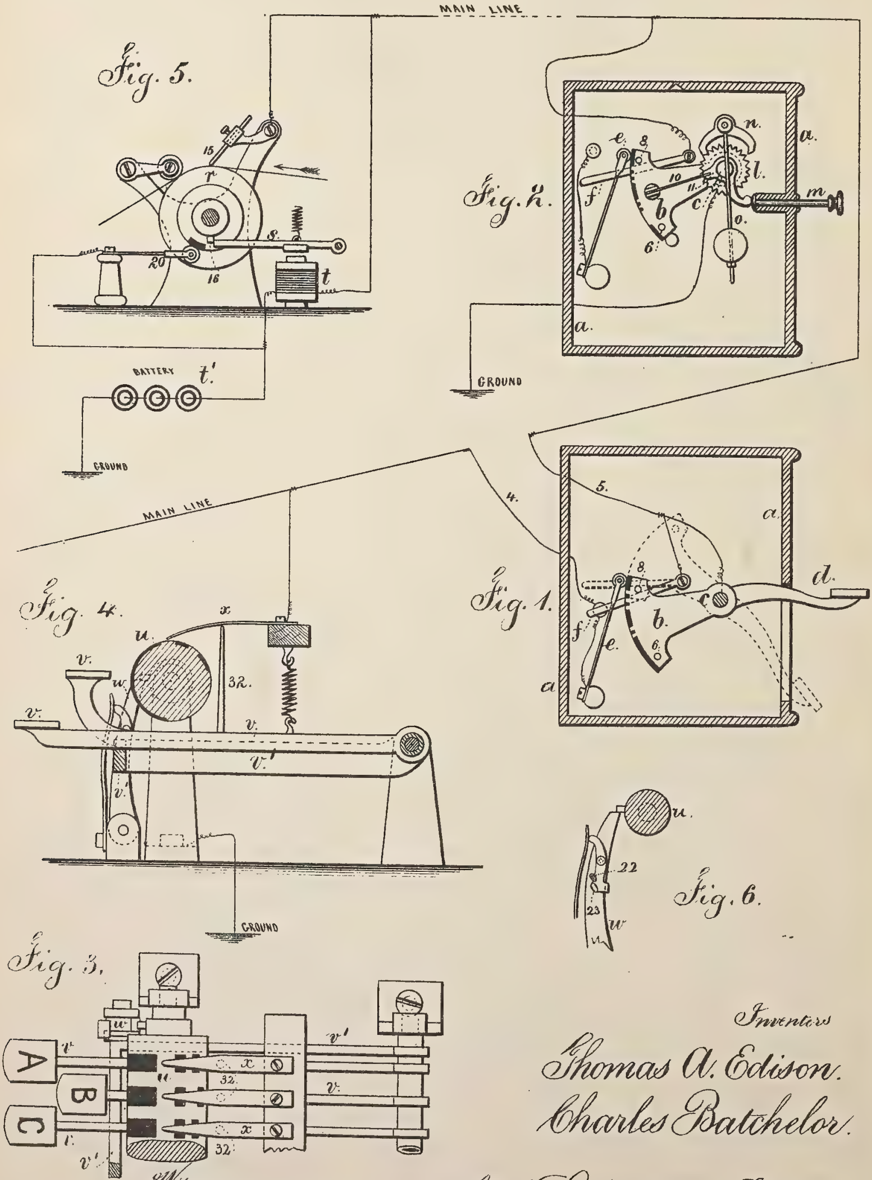
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON & C. BATCHELOR.

ELECTRIC SIGNALING-INSTRUMENT.

No. 169,972. Patented Nov. 16, 1875.



Inventors

Thomas A. Edison.

Charles Batchelor.

Witnesses

Chas H. Smith

Geo. T. Pinckney

for Lemuel W. Serrell Atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON AND CHARLES BATCHELOR, OF NEWARK, N. J.

IMPROVEMENT IN ELECTRIC-SIGNALING INSTRUMENTS.

Specification forming part of Letters Patent No. **169,972**, dated November 16, 1875; application filed March 23, 1875.

To all whom it may concern:

Be it known that we, THOMAS A. EDISON and CHARLES BATCHELOR, both of Newark, in the State of New Jersey, have invented an Improvement in Electric Telegraphs; and the following is hereby declared to be a full, clear, and exact description of the same.

This telegraph apparatus is made for local or private lines, and for alarms and messenger calls, and is known as the district alarm or domestic telegraph.

An instrument adapted to such uses has to be simple, inexpensive, durable, not easily deranged or put out of working condition, and, withal, reliable in the signal sent.

We make use of a segmental weighted lever with conducting and non conducting spaces upon its surface, so that by moving the segment in contact with a circuit-closing spring or roller, the signal will be given, and the same is received at the central station by taps on a bell or sounder, or upon chemical paper. An instrument of this general character is shown in Edison's Patent No. 154,788. We use, in connection with this district telegraph, chemical paper, upon which the mark is made by electrical decomposition, as heretofore well known; and we employ in that connection automatic mechanism that sets the paper in motion, and peculiar devices for opening and closing the circuits in connection with the transmitting-segments.

As an additional convenience, a simple finger-key instrument is sometimes employed to spell out the communication letter by letter, especially upon local and private lines.

In the drawing, Figure 1 represents one of the transmitting-instruments adapted to giving a signal in one direction only as the key is restored, instead of giving it in reverse as the key is liberated, as in aforesaid patent. Fig. 2 represents the signaling-instrument with a regulator to determine the speed of movement. Figs. 3 and 4 are a partial plan and side view of the finger-key transmitter, and Fig. 5 represents the instruments at the receiving-station.

These all are shown with circuit-wire connections to illustrate the manner in which the pulsations reach the central station without interfering with other instruments.

The small box or case *a* is adapted to being hung or fastened up against a wall, door-post, or window-frame, and within it is the segmental weight *b*, that is made to swing upon the axis or shaft *c*, and is raised by the lever or key *d*, and drops by its own weight. At the curved edge of this segment there are pieces of non-conducting material, such as hard rubber, inserted, so as to open and close the circuit through the spring *e* when the segment is moved, and these conducting and non-conducting surfaces are such that the pulsations will be sent in the prearranged order and length to denote numbers or other signs at the receiving-station, and, in some instances, two or more of these transmitting segmental weights are employed side by side in the same instrument to send different prearranged signals. A lever-switch, *f*, is introduced between the line connections 4 and 5, so that the circuit will remain closed between 4 and 5, and no pulsation will be made as the segment *b* is raised; but just as the segment reaches its upward movement, a pin, 6, lifts the switch *f*, and the electric circuit is broken between 4 and 5, so that the pulsations will be sent on the line as the segment *b* descends, and opens and closes the circuit through *b* and *e*, and the signal will thus pass to the central station. A pin, 8, restores the switch *f* to place as the segment *b* completes its downward movement.

The same thing is effected by the instrument, Fig. 2; but the main line is tapped by a branch circuit passing to the earth. This circuit, in a normal condition, is broken by the switch *f*, and that switch is moved by the pin 6 upon the extreme upward movement of the segment, so that the circuit will be complete through the spring *e*, segment *b*, and base of the instrument to the earth, and the pulsations will be made by the alternate conducting and non-conducting surfaces as the segment *b* falls. At the extreme downward movement the pin 8 moves the switch and opens the branch circuit to earth.

In order to prevent a sudden movement of the segment *b* we apply on the same shaft *c* the ratchet-wheel *l*, that is only connected to the segment *b* through the spring 10, and a yoke, 11, upon this ratchet-wheel is formed

with a lever end, to be pressed upon by the finger or by a slide-rod, *m*, and there is a pallet-escapement, *n*, and a pendulum-vibrator, *o*, which is operated by the ratchet-wheel as the segment *b* is forced up and as it falls, and prevents too rapid movement of the segment; but the spring 10 lessens the irregular movement of the segment *b*, which would result if the wheel *l* was firmly attached to the segment *b*.

At the central receiving-station the instrument is provided with a drum, *r*, over which the strip of chemically-prepared paper passes, and upon this paper the stylus 15 rests, so that a mark will be made by the electricity as it passes, and this drum is held from revolving by the armature-lever *s* and stop 16.

When the circuit is closed at the sending-station the current first passes through the magnet *t*, attracting the armature and lever, and liberating the stop 16, so that the drum *r* is instantly set in motion by clock-work and a weight or spring, so that the paper will be moved along beneath the stylus 15, and be marked by the passage of the electricity. The spring 20 rests upon a non-conducting surface, so that when the drum *r* has made one revolution and stops with the pin 16 against the armature-lever *s*, the circuit through the stylus is broken, thus compelling the first pulsation to act in the magnet *t*. The battery is shown at *t'*.

The transmitting key-instrument (shown in Figs. 3 and 4) is made with a cylinder, *u*, the surface of which is provided with conducting and non-conducting substances in lines around the periphery, as has heretofore been used, and this is driven by clock-work when liberated by depressing one of the keys *v*. The key acts upon the swinging frame *v'* to move that down, and, by an inclined finger, 22, press back the spring-stop *w*, so that the cylinder *u* will be liberated and revolved by the clock-work, and then the stop springs back to place upon the upward movement of the frame *v'*, and its finger 22 passes behind a spring projection, 23, on *w*, (see Fig. 6,) so that the stop *w* remains in place to prevent more than one revolution of the cylinder *u*.

One wire of the line passes to the journals of the cylinder *u*, and the other to the range of transmitting-springs *x*, and these are held up from the surface of the cylinder by the non-conducting studs 32; but when a key is depressed its spring *x* rests upon the surface of the cylinder, and as the latter revolves the pulsations of electricity are made to indicate the letter of the key.

We claim as our invention—

1. The combination, with the segmental circuit-closing weight, of the switch *f*, for the purposes set forth.

2. The combination, with the circuit-closing segmental weight, of the ratchet-wheel *l*, escapement *n*, pendulum *o*, and spring 10, for the purposes set forth.

3. The receiving-instrument, composed of a drum and stylus for chemical paper, and electro-magnet and armature-lever stop, and a circuit-closer insulated from the drum when the parts are at rest, for the purposes set forth.

4. The combination, with the circuit-closing cylinder *u* and keys *v*, of the springs *x*, held up by the studs 32, and the stop *w*, actuated by the frame *v'*, substantially as set forth.

Signed by us this 24th day of February, A. D. 1875.

THOS. A. EDISON.
CHAS. BATCHELOR.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

TELEGRAPH APPARATUS.

No. 171,273. Patented Dec. 21, 1875.

Fig. 1.

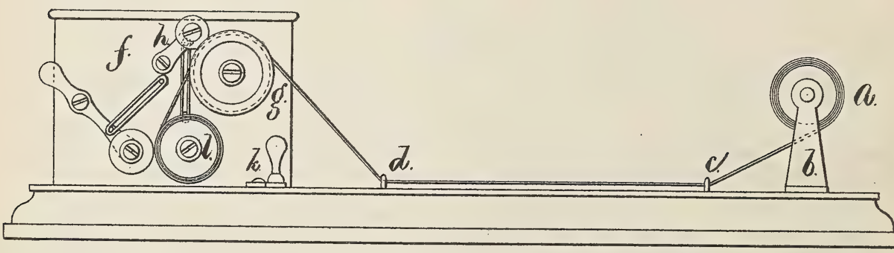
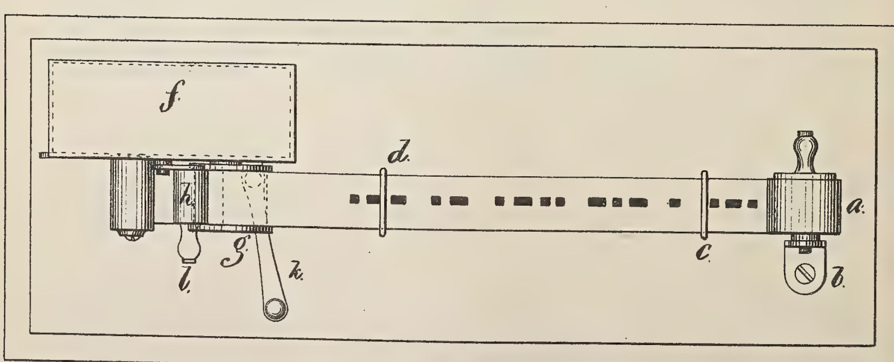


Fig. 2.



Witnesses.
Geo. D. Walker
Geo. T. Pinckney

Inventor.
Thomas A. Edison.
per. Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **171,273,** dated December 21, 1875; application filed February 16, 1875.

CASE 110.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Apparatus, of which the following is a specification:

In the chemical telegraph it is usual to write out the messages either by hand or by a type-writing machine, and the person performing this work has to draw the strip along with one hand from time to time as the transcribing progresses. The same is true with the Morse system, where the message is not written out as it is received. With the damp chemical paper great inconvenience is experienced in handling loose hanks and bunches.

My improvements contemplate the use of a roll of paper. As the message is received the strip of paper is to be wound upon a roller, and then rewound to bring the commencement of the message outward upon the roll. The strip of paper is then drawn along in front of the operator at the average speed at which the copying can be effected, and the paper is wound upon a roller, so as to be in a compact form for storage, if it is necessary to keep them.

In the drawing, Figure 1 is an elevation, and Fig. 2 is a plan, of the improved apparatus.

The roller *a*, upon which the strip of paper containing the message is wound, is placed upon a gudgeon or shaft supported by a standard, *b*, and the strip of paper is passed beneath the guide-loops *c d*, that allow such strip to be drawn along freely from right to left, and in front of the operator that transcribes or writes out the message upon the table or rest contiguous to such strip. The paper is drawn along by a train of gearing or clock-work contained within a suitable frame or box, *f*, and driven by a weight or spring, and *g* is a drum moved by one of the shafts of such train of gearing, and *h* is a yielding contact-roller, so that the strip of paper which passes between *g* and *h* will be moved along regularly, and a lever, *k*, is provided to operate a friction-clamp, by means of which the speed may be regulated to suit the operator. If desired, the strip of paper might be delivered into a basket; but I prefer to wind it automatically by a roller, *l*, that is placed upon the projecting end of one of the shafts and driven by friction, so as to wind upon itself the strip of paper as delivered. It is preferable to employ a yielding contact-roller to press the paper upon the said roller, and if there are a few points upon the surface of this roller *l* the advancing end of this strip of paper will be caught and wound up without requiring the attention of the operator.

It will be apparent that the power employed for revolving the roller upon which the paper is wound may be derived from an electric engine, or from any other source, such as a treadle or other device worked by the foot.

When the perforated strip of paper used at the transmitting end is introduced with the last end of the message first the message received will not require to be rewound, and will be in position for use.

I am aware that mechanism has been employed for moving a panoramic web and winding the same upon one roller as it is unwound from another; but this is not adapted to a strip of telegraphic paper that is removable and drawn through only once.

I claim as my invention—

1. The combination, with the rollers *g h*, actuated by a train of gearing, of guides for a strip of telegraphic paper, and a table or rest contiguous to such strip, upon which the message is transcribed, as set forth.

2. The combination, with the rollers *g h* and the removable winding-roller *l*, of the guides for the strip of telegraphic paper, and the paper-roller *a*, substantially as set forth.

Signed by me this 11th day of February, A. D. 1875.

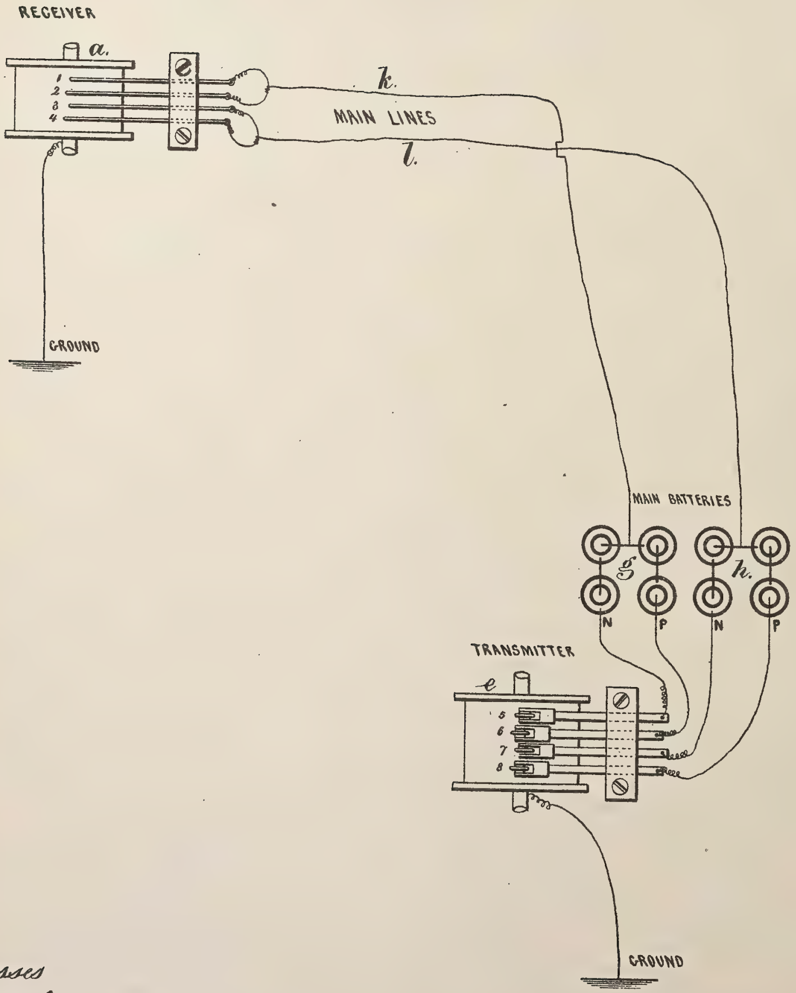
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
GEO. D. WALKER.

T. A. EDISON.

AUTOMATIC ROMAN-CHARACTER TELEGRAPH.

No. 172,305. Patented Jan. 18, 1876.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison.
per Lemuel W. Serrell atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN AUTOMATIC ROMAN-CHARACTER TELEGRAPHS.

Specification forming part of Letters Patent No. **172,305**, dated January 18, 1876; application filed January 15, 1875.

No. 92.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphs, of which the following is a specification:

This improvement is available in transmitting block or Roman characters made by perforations in a strip of paper, such as shown in my Patent No. 151,209, and receiving the same upon a strip of chemically-prepared paper.

I make use of four transmitting-rollers and two line-wires, and I arrange the rollers to act in pairs, one slightly ahead of the other, and I arrange the circuits so as to send positive or negative currents, and employ points or styluses in pairs, one of which is iron, the other tellurium, the decomposition in the chemical paper with one metal taking place with the positive current, and with the other metal with a negative current; hence, although all four points are in contact with the chemical paper, only one on each line will be operative, according to the polarity of the current passing over that line.

In the diagram on the drawing, *a* represents the receiving-roller, over which the chemical paper is drawn, as usual. 1 2 3 4 are the stylus-points, 1 and 3 being of iron. 2 and 4 are slightly in advance of 1 and 3.

At the sending station the roller or drum *e* receives the paper, which is perforated with holes, indicating block-letters, as in said Patent No. 151,209, and the paper is drawn along upon the roller *e*, as usual, and it passes beneath the circuit-closing points or rollers 5 6 7 8, and the rollers 6 and 8 are in advance of the rollers 5 and 7. There are four rows of perforations in the paper to compose the letters, so that to each row there is a circuit-closer. There are two batteries, *g* and *h*, connected to the line-wires *k l*, each line-wire being connected to the middle of the battery, and ends *n* and *p* leading to the respective circuit-closers 5 6 and 7 8; the rollers or drums *a* and *e*, respectively, being connected to the earth, and the line-wires at the receiving end being connected, one to 1 and 2, and the other to 3 and 4.

The operation is, that when either 6 or 8 closes the circuit through the perforations in the paper, a positive current passes by the ground, and the return is through the line-wire, and the tellurium point 2 or 4 makes its mark, but the iron point does not make any mark; but when either 5 or 7 closes the circuit through the perforated paper the current passes over the line-wire, returning through the earth, and the iron point marks with this current, but the tellurium does not; hence, as the rollers that work with one line-wire are one in advance of the other sufficiently for currents of opposite polarity to be sent by perforations that are in line across the strip, the marks at the receiving-station will, in consequence of the movement of the paper, occupy their proper positions, and the aggregate result will be a letter corresponding to that produced by the perforations of the transmitting-strip.

If three line-wires are employed instead of two, there may be six rows of perforations made use of in the letters.

I claim as my invention—

The combination of two or more transmitting points or rollers, arranged one in advance of the other, and the connections to the batteries and line-wires, so as to transmit positive or negative currents by the perforated paper, with stylus-points of different metals, arranged one in advance of the other, so that one marks with a negative, and the other with a positive, current, substantially as set forth.

Signed by me this 7th day of August, A. D. 1874.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

AUTOMATIC-TELEGRAPHY.

No. 173,718. Patented Feb. 22, 1876.

Fig. 1.

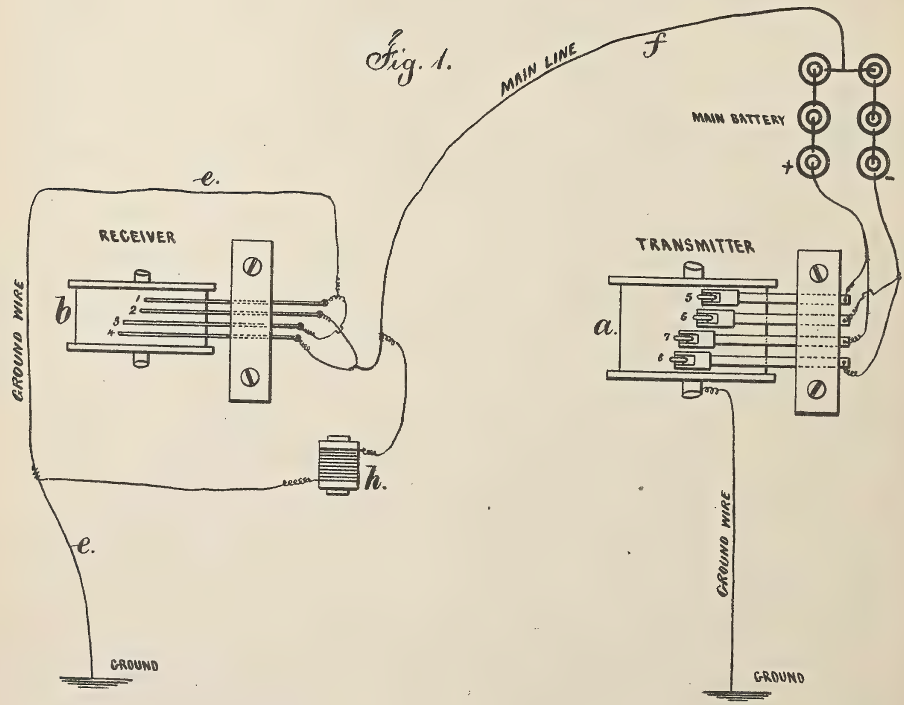


Fig. 2.

Witnesses,

Chas. H. Smith
Harold Serrell

Inventor.

Thomas A. Edison

per Lemuel W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN AUTOMATIC TELEGRAPHY.

Specification forming part of Letters Patent No. **173,718**, dated February 22, 1876; application filed January 15, 1875.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphs, of which the following is a specification:

The object of this invention is to produce block characters on chemical paper by aggregation of dots, and the transmission is effected by a strip of perforated paper, the perforations being grouped together to form the block letter, as in my Patent No. 151,209.

I make use of four lines of perforations in composing the block letter, four rollers or stylus-points at both the receiving and transmitting stations. The first pair of rollers are in advance of the second pair, and one roller of one pair and another of the other pair are connected, and act with a positive current over the lines, and the other rollers of the other pair act with the negative current. This arrangement produces the record of the letters properly in succession in dots, forming block characters; but there are also produced some false dots between the letters, that are stopped-out or obliterated by hand at the receiving-station, so that only the true characters remain visible.

In the annexed diagram the receiving-drums *a* and *b*, at the transmitting and receiving station, respectively, are operated as usual, and draw along the strips of perforated paper *c* and chemical paper *d*.

The receiving stylus-points 1 and 3 are connected to the earth-wire *e*, and the stylus-points 2 and 4 are connected to the line *f*, and between the line *f* and ground-wire *e* a small electro-magnet, *h*, is placed, so as to act to neutralize the static or induced current in the line, as explained in my Patent No. 135,531.

At the transmitting-station the rollers 5 and 7 are connected to the positive pole of the battery *l*, and the rollers 6 and 8 to the negative pole, the line-wire *f* being connected to the center of the battery, and the drum *a* being connected to the earth.

Suppose, now, that four transverse perforations, composing the letter "I," pass under the rollers 5 6 7 8; the roller 5 first sends a negative pulsation through the ground through 1 and 3, marking the paper, returning by 2 and 4 to the line, and these points 1 and 3 will mark, but 2 and 4, being a negative return current, will not. No. 1 is a true mark, but 3 is a false mark, that is obliterated, as illustrated in Fig. 2. The roller 6 now sends a positive current over the line, which goes by 2 and 4, and leaves by 3 and 1. The mark 4 is false, and is obliterated. The pulsation sent by 7 is next negative, and goes by 1 and 3, and mark 3 is true, but 1 is false, and is obliterated, and then the roller 8 sends a positive current over the line by 2 and 4, returning by 1 and 3. The mark 4 is the true one, and 2 is the false one; but, in consequence of arranging the pairs of points in advance of each other, as shown, the false marks are brought together between the respective characters, while the characters themselves stand out true and correct.

The character will be made by the pulsations as indicated, according to the arrangement of the perforations representing that character, and the false marks, being between the character, are blotted out by a boy or attendant after the strip of paper is received from the machine, so as only to leave the characters themselves apparent between the blots, as illustrated in Fig. 2.

I claim as my invention—

Four transmitting stylus-points or rollers, connected in pairs to the positive and the negative of a battery, to which the line-wire is united at the center, in combination with two stylus-points connected to the line and two to the earth at the receiving-station, the parts being arranged and operated as set forth.

Signed by me this 7th day of August, 1874.

THOMAS A. EDISON.

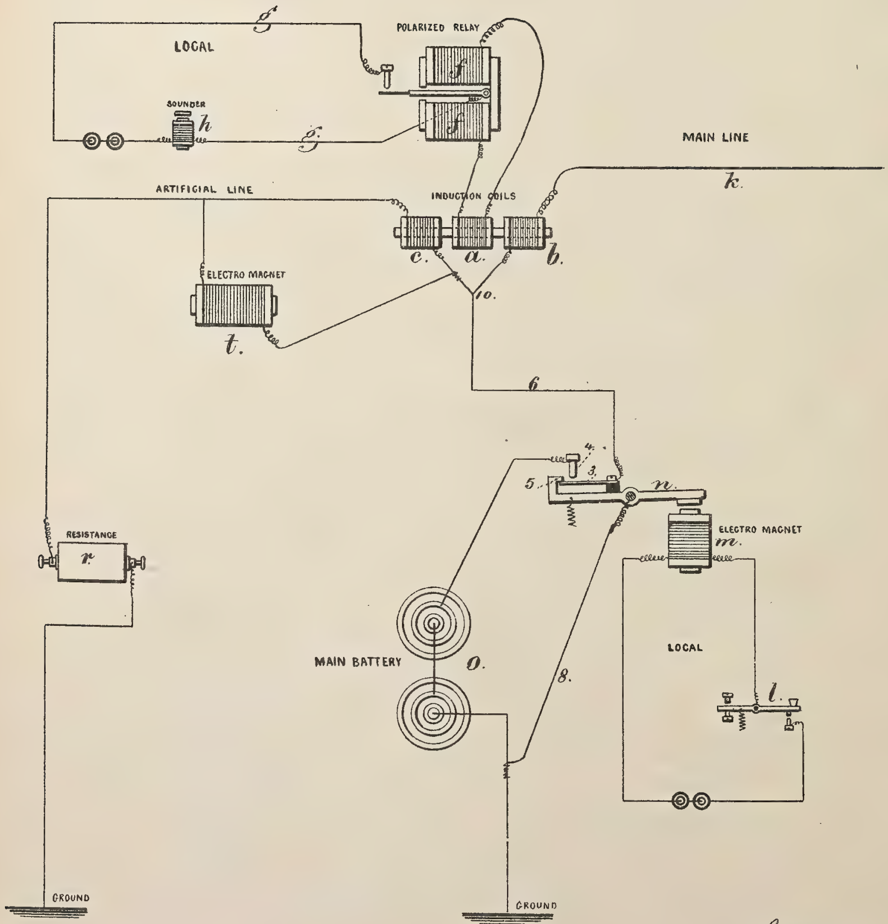
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

DUPLEX TELEGRAPH.

No. 178,221. Patented May 30, 1876.



Witnesses

Chas. H. Smith

Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT, OF NEW YORK CITY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **178,221**, dated May 30, 1876; application filed September 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

I make use of a compound induction-coil, through which the currents pass, and those from the sending-station are balanced, but the current from the distant station is operative.

The helix *a* surrounds the central part of the core that passes through the electro-magnets *b* and *c*; hence a secondary or induced current is set up in the helix *a* only when there is an excess of current in one of the helices *b* or *c*, because if the current acting in *b* is equal to that acting in *c*, and the helices are properly wound, the magnetizing actions of the helices on the core will neutralize each other, and there will not be any secondary or induced current in *a*; but when the current in one helix is greater than that in the other, the core will be magnetized, and a secondary current set up in the helix *a*.

I avail of this feature of the compound differential induction-coil to operate a duplex-telegraph instrument, by causing the current at the sending-station, where this compound differential instrument is placed, to divide and act equally in both *b* and *c*; but when the current from the distant station increases the energy of the helix *b*, then the induction or secondary current set up in the helix *a* magnetizes the core sufficiently to set up a current in *a*.

The current in *a* operates in the polarized magnet *f* to open and close the local circuit *g*, in which is placed the receiving or sounder instrument *h*.

When the pulsation passing along the line *k* from the distant station ceases, the core of the helix *b* demagnetizes, and in so doing sets up a second induced current in *a* of opposite polarity to the first, and that acting in the polarized magnet *f* instantly throws the contact-point of the armature the other way and opens the local circuit.

These operations in the compound differential induction-coil being borne in mind, it now becomes necessary to explain the manner of sending through such coils without producing any action on the helix *a*.

The key *l* in the local circuit to the magnet *m* operates the lever *n*, that contains an insulated spring-closer, 3, acting against the circuit-point 4, and the hook end 5 of the lever *n*, so that when the key *l* is closed, the lever *n* moves the spring 3 into contact with 4, closing the circuit from the battery *o*, through 4 3 and the wire 6, to the helices *b* and *c*, and at the same time breaking the contact of 3 and 5, and hence cutting out the ground-wire 8 from the lever *n*; but the moment the lever *n* returns to its normal position by the demagnetizing of *m*, the spring 3 closes the circuit at 5, just before separating from 4; hence there is always a metallic circuit complete for the pulsation coming from the distant station, whether the circuit of the sending-battery *o* is opened or closed.

In order to balance the action of the sending-current, that divides at 10, and passes through *b* and *c*, I introduce, in connection with the helix *c*, an artificial line equal in resistance and conditions to the line *k*, hence compelling an equal current to pass through *b* and *c*. To effect this the resistance *r* is placed in the ground-connection from *c*, which resistance should be adjustable, so that the rheostat or resistance *r* equals the line; and in order to set up in *c* a counter magnetism equal to that set up in *b* by the static from the line, I make use of the electro-magnet *t*, placed in a shunt that passes around *c*.

By this construction of compound differential induction-coil, and the arrangement of the connections, the inductive effects of pulsations from the sending-instrument are balanced and neutralized, while the pulsations from the distant station operate the receiving-instrument.

I claim as my invention—

1. The compound differential induction-coils *a b c*, in combination with the polarized relay *f* and the circuit-connections, substantially as set forth.

2. The artificial line, composed of the rheostat *r* and magnet *t* and ground-connection, in combination with the compound induction-coil and line-connections, substantially as set forth.

Signed by me this 19th day of August, 1874.

THOS. A. EDISON.

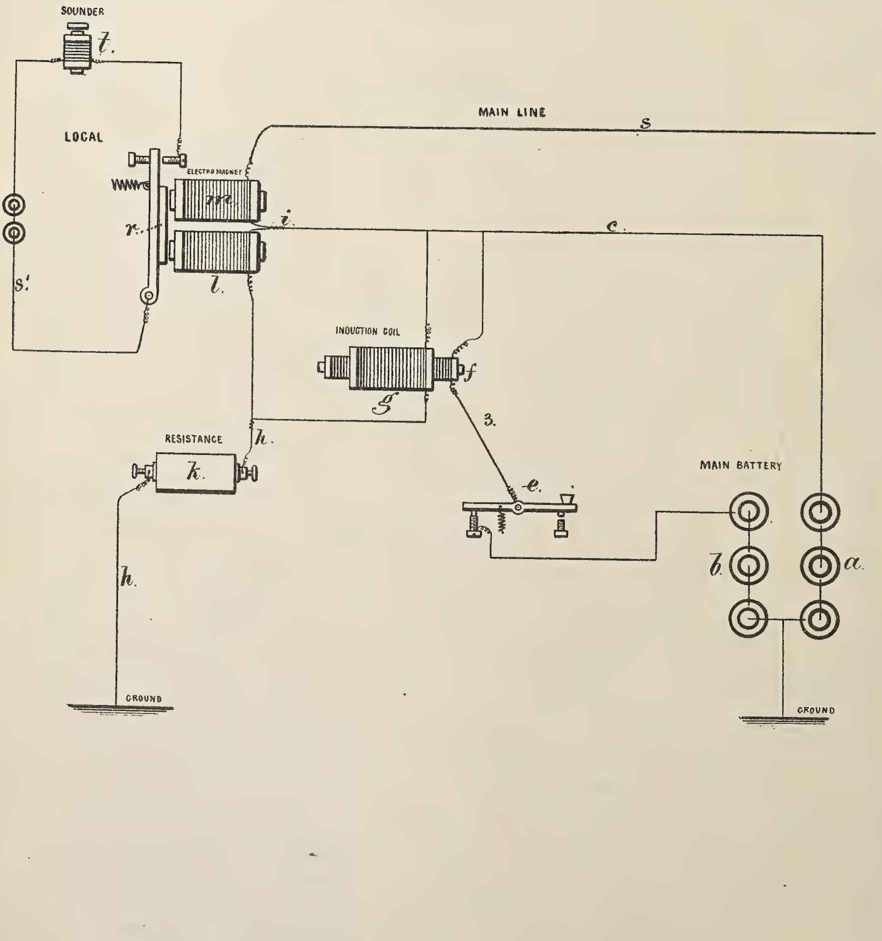
Witnesses:

CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

DUPLEX TELEGRAPH.

No. 178,222. Patented May 30, 1876.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison

per Lemuel W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT, OF NEW YORK CITY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **178,222**, dated May 30, 1876; application filed September 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

A balanced battery is used for transmitting when the balance is disturbed. An electro-magnet is used, through which both the received and transmitted pulsations pass, and the connections are made so that the action of the current sent is balanced, while that coming from the distant station is operative, to work a balanced relay and local circuit or sounder.

In the accompanying diagram drawing, the battery *a b* is connected at an end to the line-wire *c*, at the other end to the closed key *e*, and in the middle to the ground. The connection 3, from the key *e* to the line *c*, passes through the induction-coil and core *f*, and there is a second induction-coil, *g*, around the coil *f*, that is in a shunt between the line-connection *c* and the branch *h* to the ground, in which branch *h* there is a resistance, *k*, that is adjustable.

The line-connection *c* bifurcates at *i*, passing one way through the helix *l* to the ground-branch *h*, and the other way through the helix *m* to the main line *s*. The electro-magnet *l m*, being wound in the usual way, will not respond when the connection is made in the middle, because the current passing from *c* goes one way through one helix, and the other way through the other, polarizing the cores, so that the armature *r* is not attracted.

It is important that the resistance of the branch *h* and rheostant *k* should be about the same as that of the main line *s*, so as to cause the current to divide equally at *i*.

It will now be understood that any current from the distant station passing through the magnet *m*, in the usual direction, will cause the armature to respond, whether there is any current passing through the helices or not from the sending-station, and this electro-magnet *m* and armature act as a relay to operate the local circuit *s'* and sounder *t*.

The main battery, it will be seen, is in a local circuit when the key *e* is closed; hence, if both sides are equal, there is no current passing upon the main line; but when the key *e* is open the local circuit is broken, and the portion *a* of the battery sends the pulsation through *l* and *m*, and upon the line *s*, to the distant station, where the pulsation passing through *m* operates the local and sounder or receiver, the portion through *l* returning to *a* through the branch *h* and ground.

When the key *e* is closed the induction-coil *f* is charged, and it discharges when the key *e* is opened. The helix *g*, that has been charged by induction, also discharges, and sets up in *l* a current that equals that resulting from the static charge of the line, and the reverse currents are produced in the induction-coils as the circuit is closed at *e*. Thus such induction-coils serve to neutralize or balance the effect of the static charge, and prevent any false pulsation on the main line resulting from the return static charge acting in *m*.

It will be apparent that the closing of the key *e* and the connecting of the battery *b* with the line tends to set up in the line and to earth currents of opposite polarity to those resulting from the battery *a*, because the positive of the one and the negative of the other are to the ground and line, respectively, and this local circuit (*c a* 3 *e b*) serves to maintain an unbroken connection, that offers but little resistance to the pulsation from the distant instrument passing to the earth, and the resistance is nearly uniform to the current received, whether there is a current that is being sent or not.

I claim as my invention—

The battery *a b* in a local circuit, connected to the line, in which is a circuit-breaker, a finger-key, in combination with the magnet *l m*, branch *h*, and resistance *k*, and the induction-coils *f g*, the parts operating substantially as set forth.

Signed by me this 19th day of August, A. D. 1874.

THOS. A. EDISON.

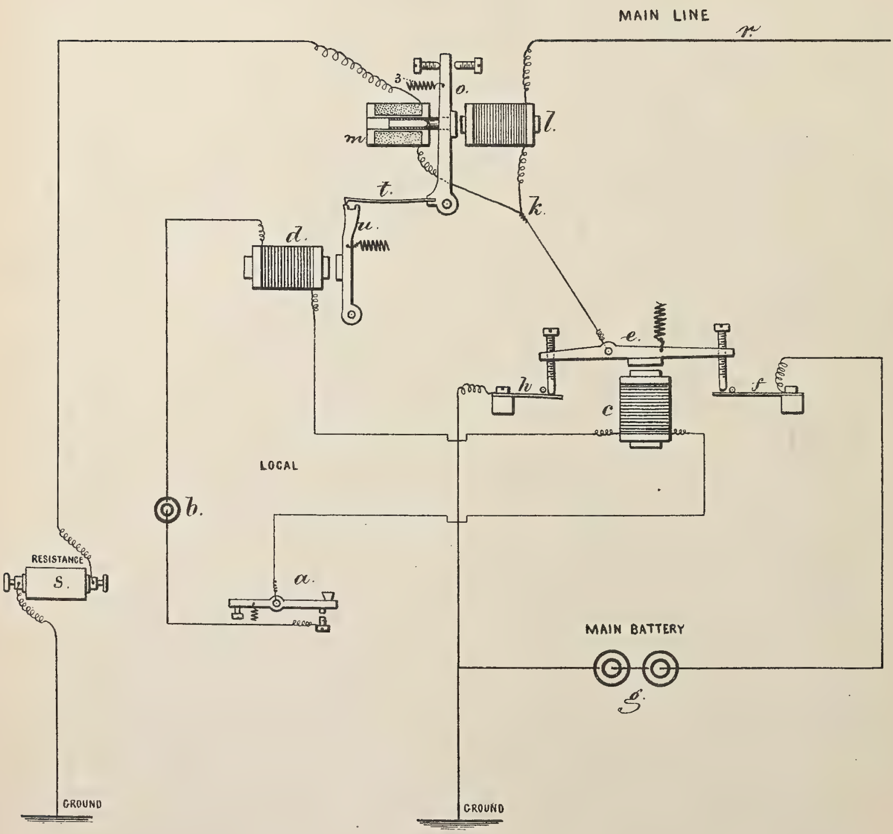
Witnesses:

CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

DUPLEX TELEGRAPH.

No. 178,223. Patented May 30, 1876.



Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT, OF NEW YORK CITY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **178,223**, dated May 30, 1876; application filed September 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, Essex county, New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

The transmitting-battery is connected with the line by a lever that simultaneously breaks the earth-connection, so as not to interrupt the continuity of the circuit. The current sent divides and operates equally in two helices. In one helix there is a sliding core that moves with the armature of the other helix, and this latter responds to the pulsation from the distant instrument and closes a local circuit to a sounder or other receiving instrument, and there is a mechanical device that serves to compensate the attraction in one of the magnets that is due to the reverse action of the static discharge, thereby causing the forces to be accurately balanced.

In the diagram of the drawing, the transmitting-key *a* opens and closes the local circuit of battery *b* to the helices of the electromagnets *c* and *d*.

The lever *e*, actuated by the armature of *c*, closes the line-connection *f* from the battery *g* just before breaking the earth-circuit of the line at *h*, so that there is always a path for the pulsation from the distant station.

The circuit from *e* bifurcates at *k*, and a portion of the pulsation sent passes through *l* and upon the line *r*, and an equal portion of the pulsation passes through *m* to the artificial line composed of the rheostat *s* and ground-connection, said rheostat being adjusted to equal the resistance of the line.

The armature-lever *o* is inoperative by the current sent, because the action of the two magnets on the same is balanced, the attractive forces of such magnets being equal; and I make the core of the magnet *m* to slide in the helix, and attach it to the armature-lever *o*, so that the cores of *l* and *m* may be equally energized, and not influenced by the current sent, whether the armature is near the core of *l* or drawn back therefrom by the spring 3.

It will now be understood that the lever *o* will not respond when the pulsation sent passes through *l m*, but that the armature-lever *o* will respond to the pulsation from the distant station, because the same only acts in *l*, and by this lever *o* a local circuit and sounder or other receiver is operated.

The pulsation sent from *g* upon the line *r* is increased by the static charge, and upon cessation of the pulsation the static charge reacts and these operations might disturb the balance between *l* and *m*. I therefore employ the mechanical compensator formed of the spring *t* and notched armature-lever *u*, to the magnet *d*; hence, when the current is closed at *a*, and the armatures of *e* and *u* are attracted, the motion of the lever *u* brings the notch at the end of such lever across beneath the V-projection on the spring *t*. Thereby the force of the spring *t* is relieved, and then again bent, and when relieved the spring 3 exerts its full power. And when the spring *t* is bent, its force lessens the power of the spring 3; hence this spring 3 is able to resist the increase of magnetism due to the static condition of the line when the circuit is closed, and to compensate for the reaction of the static charge as the circuit at *a* is broken, thus leaving the magnet *l* entirely uninfluenced by the current sent, and capable of the most delicate adjustment by the spring 3 for receiving from the distant station.

It is to be understood that the effect of the static electricity is apparent when the magnet *l* is charged and discharged, and that at that moment the notch in the end of *u* relieves the end of the spring *t*, allowing the increased power of the spring 3 to compensate for the static electricity acting in the magnet *l*.

I claim as my invention—

1. The magnets *l m*, through which the current sent passes to the line, and artificial line, in combination with the armature-lever *o*, and sliding core, substantially as specified.

2. The electro-magnets *c d*, in the local circuit containing the circuit-breaker *a*, in combination with the circuit-closing lever *e*, notched armature lever *u*, spring *t*, and armature-lever *o*, substantially as set forth.

3. The mechanical compensator, consisting of the spring *t* and notched lever *u*, for neutralizing the effect of the static charge in a duplex telegraph, substantially as set forth.

Signed by me this 19th day of August, A. D. 1874.

THOS. A. EDISON.

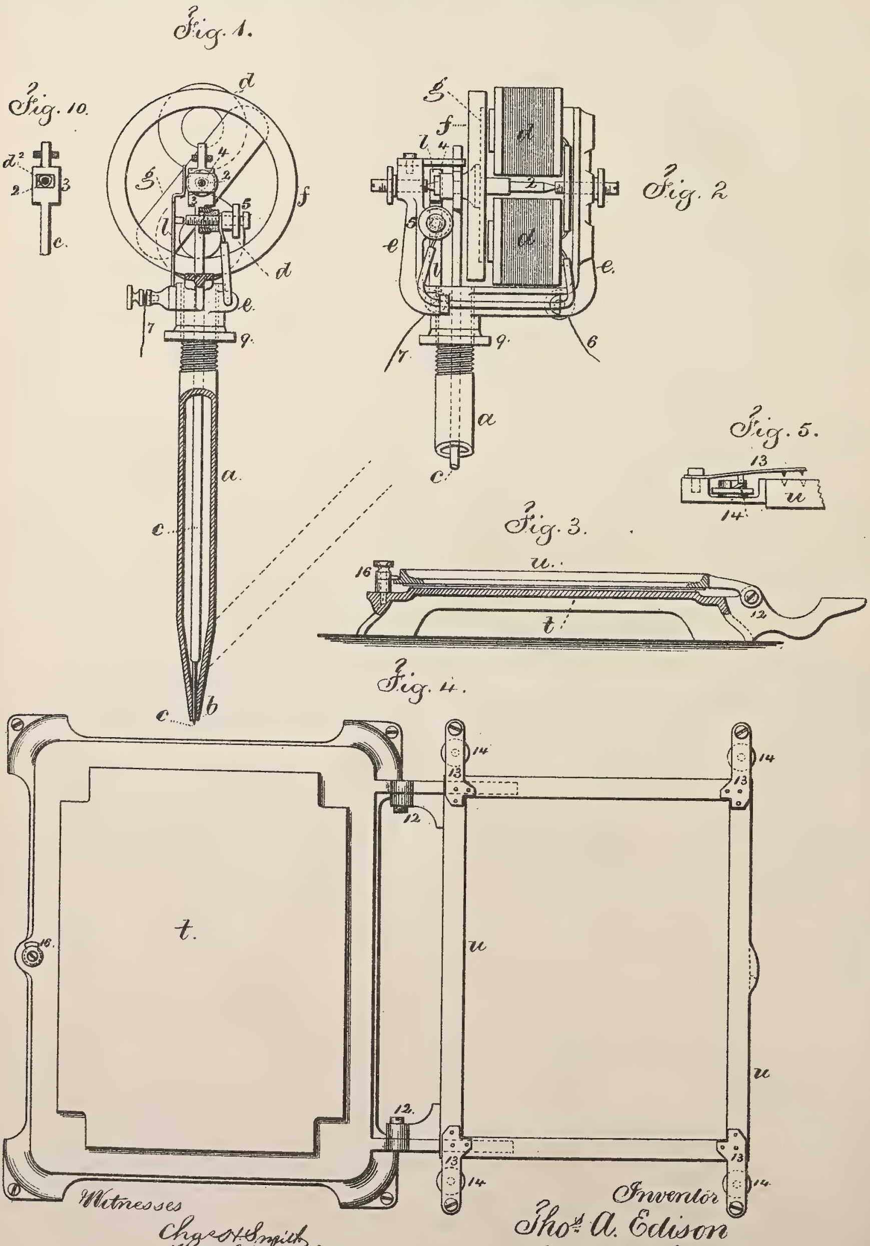
Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

2 Sheets—Sheet 1.

T. A. EDISON.

AUTOGRAPHIC PRINTING.

No. 180,857. Patented Aug. 8, 1876.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thos. A. Edison
per Lemuel W. Serrell atty.

2 Sheets—Sheet 2.

T. A. EDISON.

AUTOGRAPHIC PRINTING.

No. 180,857. Patented Aug. 8, 1876.

Fig. 8.

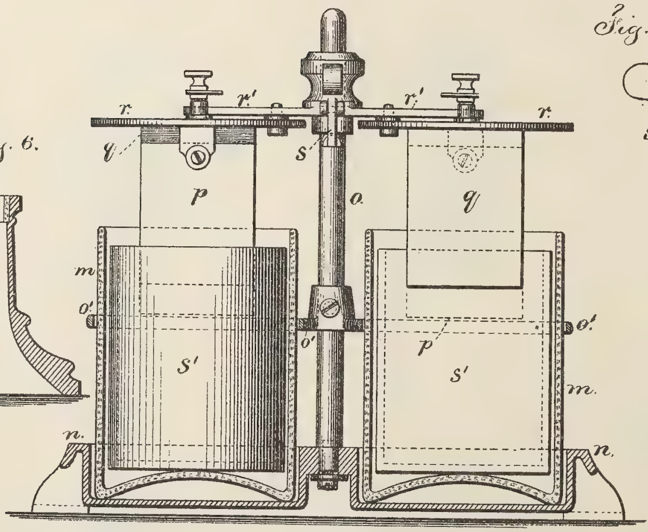


Fig. 9.

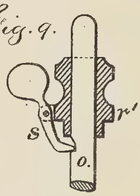


Fig. 6.

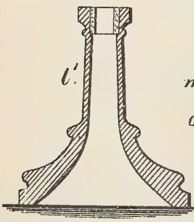
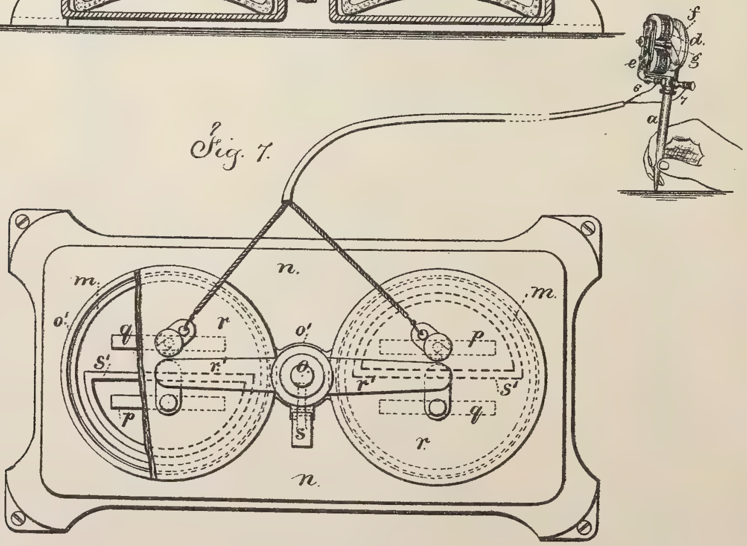


Fig. 7.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thos. A. Edison.
per Lemuel W. Serrell
att'y

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN AUTOGRAPHIC PRINTING.

Specification forming part of Letters Patent No. **180,857**, dated August 8, 1876; application filed March 13, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Autographic Printing, of which the following is a specification:

Patterns for embroidery and for fresco painters have been made of paper, perforated with numerous holes in the lines to be transferred, and the transfer has been done by a fine colored powder, dusted over and rubbed into such holes while the article is upon the surface that receives such transfer. This is not adapted to writing, because the color employed is not permanent, and no means has been devised that could easily be made use of in writing or drawing by hand with rapidity that rendered the operation practically available for autographic printing.

My improvement relates, first, to the instrument employed for puncturing the paper, whereby such instrument can be used by hand in the same manner as a drawing or writing pen; second, to the method of printing by direct transfer in permanent semi-liquid ink from the perforated sheet; and third, to the press for holding such transfer-sheet, and the paper to be impressed.

In the drawing, Figure 1 is a vertical section of the pen or stylus, in a form that I have discovered to be very convenient in use. Fig. 2 is a side view of the actuating-magnets. Fig. 3 is a section of the press. Fig. 4 is a plan of the same, as open. Fig. 5 is a section of the paper-holding clamp. Fig. 6 is a section of the pen-holding stand in smaller size than the pen Fig. 1. Fig. 7 is a plan of the battery, illustrating, also, the flexible connection to the distant pen as in use. Fig. 8 is an elevation of the battery, partially in section; and Fig. 9 is a section of the pole-supporting catch of the battery.

The pen which I make use of consists of a tube, *a*, tapering to a small point, *b*, and a needle, *c*, within that tube, which needle is reciprocated with great rapidity; and when the needle-point *c* is projected it is sufficiently long to reach through the paper upon which the tube of the pen rests, and when retracted the needle is drawn within the tube, so that the small end thereof is free to be moved from place to place.

The great rapidity in the movement of the needle-point produces the punctures in the paper sufficiently close together to form lines when the pen is manipulated in writing or drawing; and, as nothing is removed from the paper, its strength is not materially injured by the punctures or perforations; and it will be apparent that any suitable device may be employed for reciprocating the perforating-needle; and as I have invented numerous devices for which I contemplate applying for Letters Patent hereafter, I have only shown herein the device which I prefer to use, viz: an electro-magnet and revolving-armature fly-wheel.

The electro-magnet *d* is upon the frame *e* that supports the axis 2 of the fly-wheel *f*, and this fly-wheel is connected with the armature *g*. Upon the axis 2 there is an eccentric or a cam, with one or more arms acting upon the stock 3 at the upper end of the needle-bar. It is preferable to employ a three-pointed cam, d^2, as seen in Fig. 10, upon the axis 2, so as to give three up-and-down motions to the needle-point each revolution of the axis 2.

The commutator or circuit-closer to the electro-magnets is composed of the spring *l*, acted upon by the notched or flattened disk 4 to open and close the circuit through the screw 5, and thus actuate the electro-magnetic motor in the usual manner.

The wires 6 and 7 lead to the battery shown in Figs. 7 and 8, in which the glass cells *m* are in a metal stand, *n*, held by the standard *o* and ring *o′*. The carbon-pole *p* and zinc-pole *q* are connected with the cover *r* and cross-bar *r′*, that are fitted to be raised or lowered upon the standard *o*, and when raised out of use, as in Fig. 8, the parts are held up by the latch *s* passing into a notch in the standard *o*, as in Figs. 8 and 9. The porous cups *s′* in the cells *m* are nearly half-cylinders, as shown. This construction of battery is very convenient for this autographic pen, because it occupies but little space and is easily transported and

brought into or put out of action. The liquids preferably employed in the battery are bichromate of potash and sulphuric acid.

The tube of the pen screws into the frame e, and it is provided with a set-nut, 9, by means of which it can be clamped after the tube has been adjusted, so as to allow the needle to be drawn into the tube and projected by the motor as aforesaid.

A stand, l', Fig. 6, is provided with a hole at the upper end, of a size to receive the tube of the pen and support the same, and protect the point from injury when entered within such stand. The conductor from the pen to the battery must be flexible, so as to allow the pen to be easily moved about in performing the writing.

The mode of printing from the perforated sheet is to fill the holes with ink by means of a roller applied to the right side of the perforated sheet; and then when said ink is well worked into the holes to place beneath such perforated sheet the paper upon which the impression is to be made, and then pass over the perforated sheet a roller that presses the ink through the perforations to the surface of the sheet below.

As a convenient means for doing this printing, I make use of the bed t, to which the frame u is hinged at 12, and at the corners of this frame u are the spring-plates 13, with holding-points; and these spring-plates are raised from the surface of the frame by turning the cam-buttons 14, so that the perforated sheet can be placed between the frame and these clamping-springs; and then the cam-buttons 14, being turned the other way, allow the springs to catch and firmly hold the corners of the perforated sheet. A sheet of paper is now laid down upon the bed t, the frame u turned over upon it and secured by the clamping-button 16 being turned over the edge of this frame u. A roller, covered with felt or other similar material, and having ink upon its surface, is now rolled over the perforated sheet until all the holes are filled and an impression made by the ink through such holes upon the surface of the sheet below. The hinged frame holding the perforated sheet may be lifted for inspecting the impression, and closed down again if the impression is defective at any part. After the holes are filled the impressions upon other sheets can be made in succession very rapidly, and a small quantity of ink is added from time to time. Printer's ink, thinned out with castor oil, may be employed, or aniline colors may be used, mixed with glycerine and molasses.

Various forms of electro-magnetic motors may be employed to revolve the shaft that reciprocates the puncturing-needle, and the movement of a vibrating armature might be transferred directly to the needle, if desired.

It is generally preferable to have the perforating-needle perpendicular to the paper; and, for convenience in holding the same, there may be a handle connected with the pen-tube a, and occupying an inclined position, as indicated by the dotted lines, Fig. 1.

I claim as of my invention—

1. The portable perforating instrument for writing or drawing, composed of a tapering tubular stock, adapted to be held and moved by hand, and provided with a perforating-needle and its reciprocating mechanism, substantially as specified.

2. The method herein specified of printing in permanent semi-fluid ink by puncturing a sheet of paper, or similar material, with numerous small holes, filling such holes with a semi-liquid ink, and pressing the same upon the surface to be printed, substantially as set forth.

3. The swinging frame u and paper-holding clamps 13, in combination with the bed t, for receiving and holding the sheet of perforated paper, and the sheet to be printed, substantially as set forth.

4. The combination with the revolving magnetic motor, pen-holder a, and puncturing-needle c, of the cam d^2, having three or more points, substantially as set forth.

5. The combination, with the portable hand-perforating instrument having an electro-magnetic motor, of a flexible conductor and a battery, substantially as set forth.

6. The portable galvanic battery composed of cells in a stand, with a pole-supporting rod, latch, and cross-head, in combination with flexible conductors, a magnetic motor, and a perforating-pen, substantially as set forth.

Signed by me this 7th day of March, A. D. 1876.

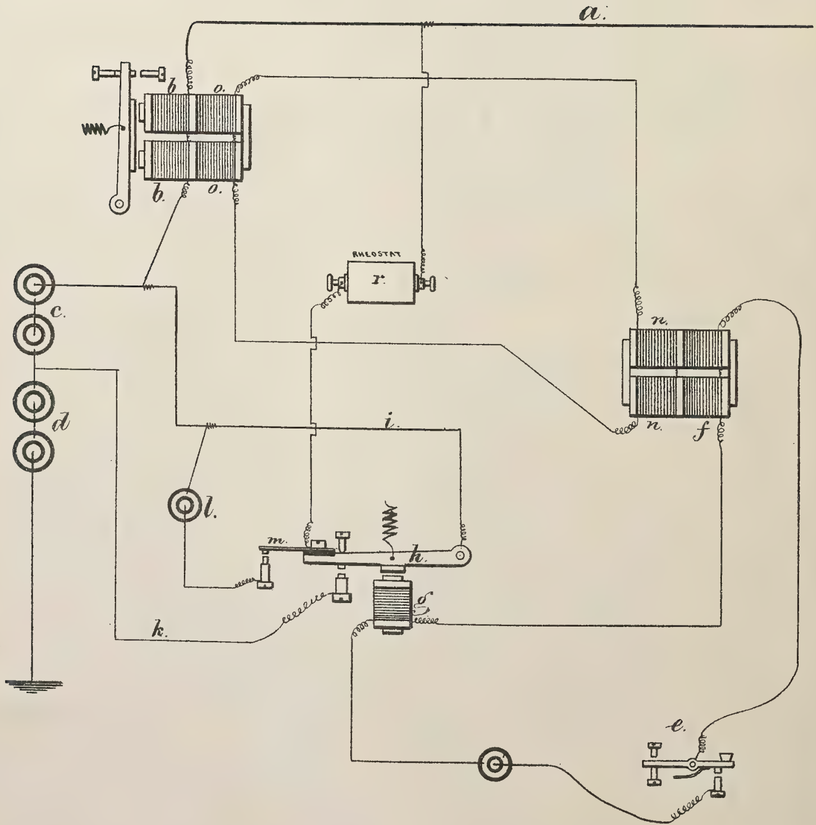
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

DUPLEX TELEGRAPH.

No. 180,858. Patented Aug. 8, 1876.



Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thomas A. Edison
per L. W. Serrell
atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT, OF NEW YORK CITY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **180,858**, dated August 8, 1876; application filed September 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

The main battery is in two parts connected in reverse in the line-circuit. In the same circuit is the receiving instrument or relay, to which is connected a local circuit and sounder. One-half of the battery is short-circuited at the sending-station by the depression of the key. Simultaneously with this depression a local circuit is closed and a reverse current sent from a battery through the receiving-magnet, and in that circuit is a rheostat that is adjusted so that the effect of the battery on the line is neutralized in the receiving-relay at the sending end; but the battery at this distant end is free to act at the receiving-station. At the same time the effects from the static charge in the line are neutralized in the receiving-instrument by induction.

In the diagram, *a* is the line passing through the electro-magnet *b* that operates a relay or sounder. The connection from *b* is through the batteries *c d*, or local circuit *i l k*, to the earth. The batteries *c* and *d* oppose each other, and, being equal, are not operative in *b*. The key *e* is in a local circuit, in which are the helices *f g*, and when the key is closed the electro-magnet *g* attracts the armature and lever *h*, closing the circuit *i k* to the center of the batteries *c d*, hence short-circuiting *c*, and allowing *d* to act in the line. In order to compensate the action of the battery *d* in *b*, the local battery *l* is used, and the local circuit from *l*, through the insulated spring *m* and rheostat to the line *a*, is closed simultaneously with the short-circuiting of *c*, and this rheostat *r* is adjusted so that the action of *l* in *b* equals the action of *d* in *b*, and, being in reverse, the forces are neutralized. The helices *f* and *g*, being charged and discharged simultaneously, there is an inductive current set up in the core of *f* and the helix *n*, and that gives a secondary charge to the helix *o* that surrounds the core of *b*, and hence when *e* is closed the secondary effect in *n* neutralizes the static effect as the line is charged, and, as the circuit at the key *e* is broken, a reverse induction-current is set up in *n*, neutralizing the discharge of the static charge of the line, the helices being wound so as to produce this reverse and neutralizing effect in the core of the electro-magnet *b* of the helix *n*.

I claim as my invention—

1. The local equating-battery *l*, and rheostat *r*, connected to the line *a*, and to the receiving-magnet *b*, in combination with the batteries *c d*, shunt *i*, and lever *h*, substantially as and for the purposes set forth.

2. The magnets *g* and *f*, and induction-coils *n o*, in combination with the magnet *b*, batteries *c d*, and shunt-circuits, substantially as set forth.

Signed by me this 19th day of August, A. D. 1874.

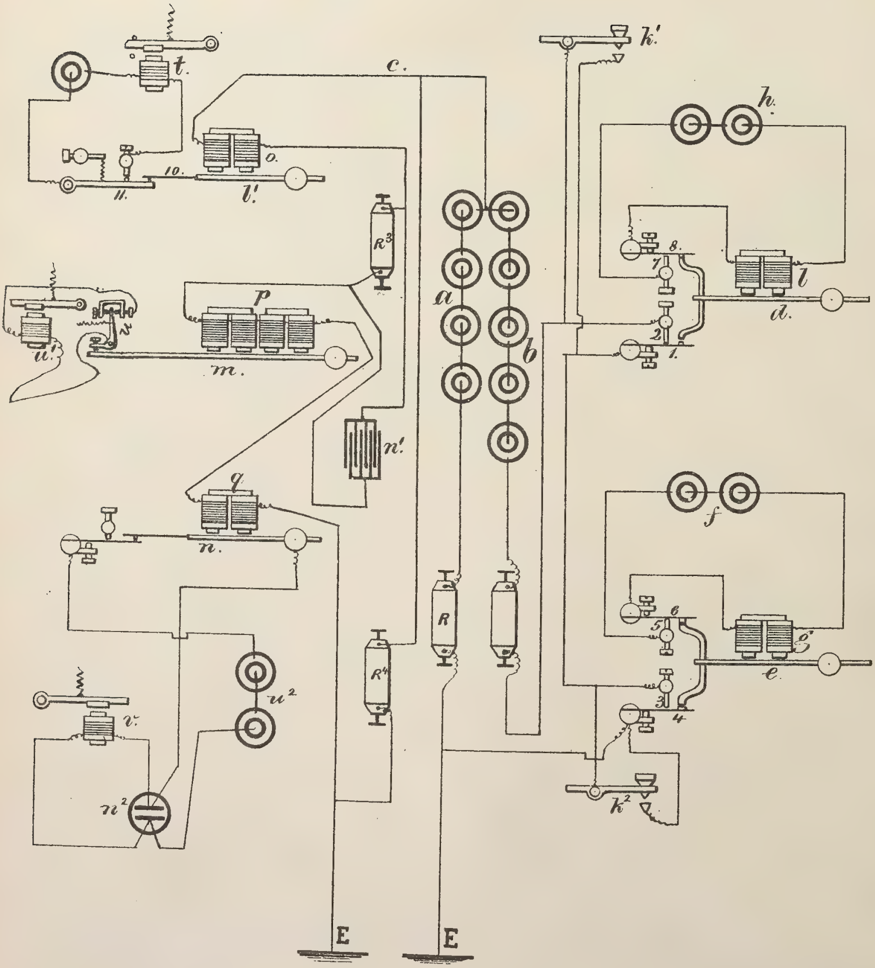
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

ACOUSTIC TELEGRAPH.

No. 182,996. Patented Oct. 10, 1876.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

Atty

- JAMES R. OSGOOD & CO. BOSTON. -

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN ACOUSTIC TELEGRAPHS.

Specification forming part of Letters Patent No. **182,996**, dated October 10, 1876; application filed May 16, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

Two batteries are connected to the line and to the earth, and the earth-connection from one is direct, and in the earth-connection from the other are the tremolo circuit-closers of the reeds, and also finger-keys. When one tremolo is short-circuited by its key, the other tremolo only is operative in sending pulsations over the line, and the distant reed responds to the same. When both are operative in sending pulsations, both receiving-reeds at the other end respond. One battery is slightly stronger than the other, and when the short circuit of the stronger battery is broken the other battery is operative upon the line, and when the other circuit is closed to the earth the weaker battery is overpowered and a weak pulsation sent upon the line, clearing it of its static charge. In this manner the pulsations from the tremolo circuit-closers can be very rapid, and, the batteries being connected with opposite poles to the line, the static effects are neutralized by the transmission of a slight contrary current, due to the excess of one battery over the other.

The battery is made of the minor element *a*, and major element *b*, with zinc of *a*, and copper of *b*, to line. The battery *a* is connected to earth E through rheostat R, and from the battery *b* to earth there is a circuit-wire, in which are the tremolo circuit-closers 1 2 and 3 4. The key k^1 short-circuits the tremolo 1 2, and the key k^2 short-circuits 3 4. The reeds or other vibrating bodies *d e* are operated and kept in vibration by the local circuits and electro-magnets, the battery *h*, magnet *l*, and circuit-closers 7 8 acting with the reed *d*, and the battery *f*, magnet *g*, and circuit-closers 5 and 6 acting with the reed *e*.

The operations of the transmitting portion of the instrument will be apparent. The reeds *d* and *e* being constantly vibrated, and vibrating at different rates of speed, as in other acoustic telegraphs, the circuits at 1 2 and 3 4 will be opened and closed in harmony with the respective reeds, and the pulsations will pass over the line from the battery *a* whenever the circuit of battery *b* is broken, the power of battery *a* being free to act and pass over the line; but when the circuit of *b* is closed an excess of current passes from the battery *b* into the line, to neutralize static effect and clear the line. When either key k^1 or k^2 is closed, the corresponding tremolo circuit-closer becomes inoperative on the line because of the continuous metallic connection short-circuiting the same. The other tremolo circuit-closer, however, may be fully operative. By this means the cessation of vibration of the receiving-reed, or its equivalent, corresponds with the circuit-closing of the finger-key at the sending station, and the vibration denotes a state of rest of the finger-key. If the normal condition of the finger-key was a closed circuit through it, then the signal would result from the vibration of the reed at the receiving-station corresponding to the opening of the finger-key circuit.

At the receiving-station the line *c* divides, and one branch passes by the rheostat R^4 to earth. The other passes through electro-magnets *o p q* to earth, and adjacent to these magnets are the vibrating reed-armatures toned to respond to the reeds of similar notes at the sending-station. There is a rheostat, R^3, that is shunted by the condenser n', the object being to avail of the discharge of the condenser to neutralize the static charge of the line. The rheostats are to be of proper resistance to effect this object. It is preferable to employ four spools, or a double electro-magnet at *p*, to operate upon the reed *m*, which is advantageous upon reeds of a high note, as they require more power than those of a low note to vibrate them. The poles of the electro-magnets are preferably arranged so that the two north poles come next each other, or the reverse, so that the inductive effects upon the reed will be neutralized, and tendency to stick avoided. The reed l' is prolonged in the form of a very light strip of metal, 10, that is, by preference, corrugated, to render it stiff. By this means a greater range of motion is obtained to operate the circuit-closer 11 of the local circuit and sounder *t*.

The reed m operates at the end against the short end of a lever, u, which may be a bent lever, so that the long end has greater range of motion and operates more reliably as a circuit-closer for the sounder u^1 in a local circuit than the reed itself. This lever u is positioned so that it is only operated by the reed m, when in full vibration; hence the local circuit-closer will not act when the magnet p ceases to operate upon the reed. The reed n opens and closes a local circuit passing through itself from the local battery u^2, and there is a secondary battery or acidulated cup, n^2, in the same circuit. The rapid vibrations of the reed n induce a constant magnetism in the sounder v in consequence of the secondary battery prolonging the current and preventing magnet v discharging until the reed n pauses in its vibration; hence the sounder or receiving-instrument v will be demagnetized and respond to the closing of the distant finger-key.

If the sending-instruments are placed at an intermediate station, the batteries a b may be in branches or derived circuits in the main line.

I claim as my invention—

1. In an acoustic telegraph, two sections, a b, of the battery, in derived circuits from the main line, in combination with resistances and a tremolo circuit-closer operated by the reed, or its equivalent, and placed in one of the battery-circuits, substantially as set forth.

2. In an acoustic telegraph, a battery, in two sections, connected to the line, and to derived circuits, in combination with tremolo circuit-closers, reeds operated by magnets, and keys to short-circuit the circuit-closers, substantially as set forth.

3. The combination, with an acoustic telegraphic reed, of an extension that is lighter than the reed, to operate circuit-closing devices, substantially as set forth.

4. The combination, with an acoustic receiving-instrument, of a derived circuit from the main line containing a condenser, and a resistance in the main line, substantially as set forth.

5. The combination, with a vibrating reed in an acoustic telegraph, of four electro-magnet spools placed in the main line, substantially as set forth.

6. The combination, with the vibrating reed m, of the lever u, and local circuit, arranged so that the lever u is only acted upon by the reed m when in full vibration, substantially as set forth.

7. The combination, with an acoustic telegraph, of a local circuit, a secondary battery, a receiving-instrument or sounder, and a circuit-closer operated by the reed, substantially as set forth.

Signed by me this 9th day of May, A. D. 1876.

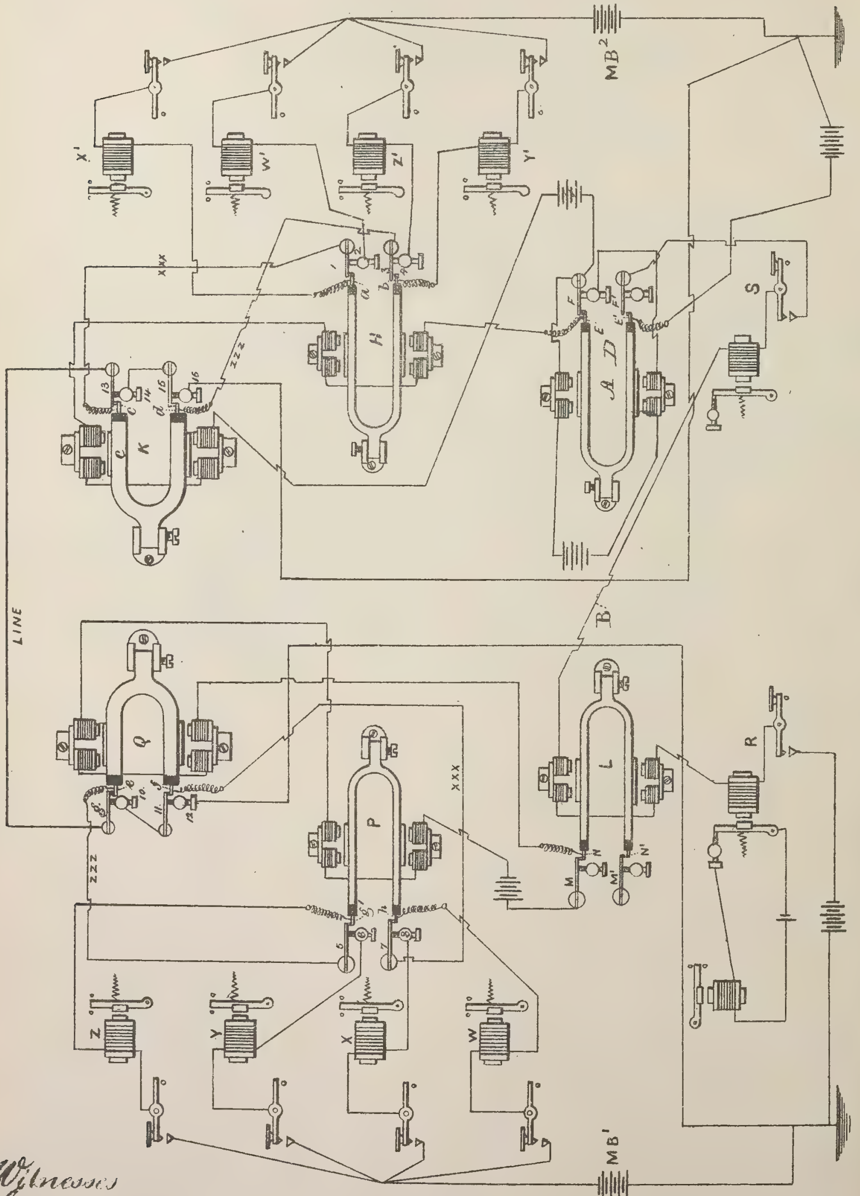
THOS. A. EDISON.

Witnesses:
J. D. Russ,
Chas. Batchelor.

T. A. EDISON.

ELECTRO-HARMONIC MULTIPLEX TELEGRAPH.

No. 185,507. Patented Dec. 19, 1876.



Witnesses
J. W. Soren
H. M. Haigh

Inventor
Thos. A. Edison
per Lemuel W. Serrell Atty

THE GRAPHIC CO. N.Y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN ELECTRO-HARMONIC MULTIPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **185,507**, dated December 19, 1876; application filed August 31, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

The object of this invention is to subdivide a single telegraphic circuit into a number of independent signaling-circuits, each of which may be operated by means of the signaling apparatus in ordinary use, and signals transmitted upon each signaling-circuit without interfering with the others, and in either direction at pleasure.

The invention consists, first, in a method and combination of apparatus for transferring a telegraphic line or circuit at two or more stations, either terminal or intermediate, successively from one set of signaling-instruments to several other sets of signaling-instruments, by the use of tuning forks or reeds at each station, kept in continuous vibration, by electro-magnets, with such rapidity and in such a manner that the brief time during which the circuit is disconnected from any one pair of signaling-instruments and returned thereto is not sufficient to interfere with the proper transmission of signals.

Second, the invention further consists in placing in the same circuit two tuning-forks or equivalent devices, one of which, in respect to the number of its vibrations in a given time, is a submultiple of the other, so that the high forks shall subdivide the wire into two signaling-circuits, which latter, being connected to the low fork, are thereby again subdivided into four signaling-circuits.

Third, the invention further consists in the method and combination of apparatus employed to control and regulate the transferring forks or reeds by means of the other tuning-forks, reeds, or moving bodies following the law of the pendulum, which are actuated by electro-magnets placed in a second circuit, and arranged to close at each vibration the local circuit, by which the transfer-forks are kept in vibration.

Fourth, the invention further consists in a method and combination of devices whereby the transferred circuit is momentarily connected to the earth during its passage from one set of signaling-instruments to another.

Fifth, the invention further consists in the combination of transfer-reeds, together with their signaling-instruments, local circuit, and batteries, with the main-line reed or reeds, by which means the accurate transfer of the main circuit upon the several instruments is effected.

Sixth, the invention further consists in the combination of signaling-instruments with the auxiliary or controlling circuit, in such a manner that it may be utilized for the transmission of signals, as well as for controlling the apparatus attached to the other line.

Seventh, the invention further consists in the placing of several sets of electro-magnetic transfer forks or reeds in the same local circuit at each of the different stations, whereby they are maintained in harmonious vibration with each other at all times.

I will now describe the various devices. A is the fundamental fork, which may either be in the main circuit of the controlling-line B, or in a local circuit. I have shown it in the latter. The fork makes, say, thirty-six vibrations in each second. (I do not confine myself to thirty-six, as twelve to five hundred will answer.) D is the contact devices, whereby the circuit in which the actuating-magnets are placed is opened and closed at each vibration, thus causing the reed to vibrate continuously. Upon the extreme ends of the prongs are insulated contact-points E and E′, which come in contact with springs F and F′. The contact of E and F serves to close and open the local circuit, in which the transfer-reeds H and K are placed, while the contact of E′ and F′ serves to close and open the controlling-circuit. This sets the fork L in motion, which, in its turn, by means of M and N, closes and opens the local circuit in which the forks P and Q, are setting them in motion. Now, if the contact time of the various springs and points upon the controlling-forks A and L is the same, the forks H, K, P, and Q will vibrate exactly in unison, and continue to do so, although a great variation may take place on the controlling-wire, in which A and L are placed. R and S are two signaling-instru-

ments, which are ordinary Morse apparatus, with the exception of the relays and keys having back points, the signaling-sounder closing when the circuit is opened by depressing the keys.

I will mention that signaling may take place at the same time that the fork L is working without interruption to it, as it requires from fifteen to twenty-five seconds after the controlling-wire is opened before its vibration becomes insufficient to open and close the circuit of the forks P and Q, and as a Morse signal only requires a fraction of a second, these slight openings do not interfere with the fork.

I will here mention that the signaling might be done by cutting in and out resistance by the keys, or by the insertion and withdrawal of an extra battery by the same means; but I prefer to use the method shown.

It is even possible to transfer the controlling-circuit to the signaling-instrument R and S at that moment when the controlling-line is to be opened, the same effect as opening being obtained by polarizing the armatures upon the forks, so that they will respond to a positive current, and causing magnetic effect to cease by cutting in the circuit the signaling-instrument and a negative battery.

The points M′ and N′ of L may be used to open and close another local circuit containing another set of forks, which can be used for another line, extra points of course being added to A to work a similar set of forks.

Having now described my method of obtaining a perfect synchronous vibration of the several forks at the terminals, I will now describe how the second circuit is transferred upon the several signaling-circuits simultaneously.

The line to be transferred is connected first to the springs *g* of fork Q and 13 of fork K. The springs 11 of Q and 15 of K are also connected to the line, when *g* and 13 rest against the limiting-points 10 and 14. The points 12 of Q and 16 of K are in connection with the earth. When the forks Q and K are not in vibration, the springs *g* and 11 of the former and 13 and 15 of the latter are not in contact with either *c d* of K or *e f* of Q, they being so adjusted that the prongs must reach a considerable amplitude before they are brought in contact. This allows the wire to be put to earth at both ends—for instance, starting from the left, and proceeding toward K, the line enters the spring 13; thence, through to point 14, to spring 15; thence to point 16, to earth; from earth at the receiving-station to the point 12 of Q; thence, *via* spring 11, to point 10; thence to spring *g*, to line, thus putting the line to earth each time that the forks Q and K vibrate, and at that period of the vibration when they are in the position they would be if in a state of rest. If, now, both forks vibrate, *c* and *e* will be brought in contact with springs 13 and *g*, thus disconnecting the line from earth, and throwing it to the forks H and P, whose action will be presently described. While this contact continues the other prongs of Q and K recede from 15 and 11, and perform no work. On the return of *c* and *e*, the springs *g* and 13 rest for a moment upon 14 and 10, and as 15 and 11 are, at the particular period, and for a time afterward, in contact with 16 and 12, the line will be put to earth in the manner before described, and will continue in this way until the prongs *d* and *f* come in contact with the springs 15 and 11, separating them from the earth and connecting them to the reeds H and P. Thus it will be seen that the line is split in two parts and put to earth at that period of time when neither H or P are in connection with it.

Having now shown how the wire is split into two parts, I will now describe the method of still further subdivision.

The wires from *e* and *f* of Q and *c* and *d* of K proceed to springs 1 2 of H and 5 and 7 of P. *g*′, 6, 8, and *h* of P are connected to the signaling-instruments W X Y Z and their keys and battery M B′, and the same connections are made with H.

The operation is as follows: When *g*′ of P is in contact with 5, 6 of *h* is in contact with 3. At the same instant that contact is thus made, the forks Q and K connect the wires from *d* and *e* with the line. Now, at the same time, *h* and 7 of P and *a* and 1 of H are in contact, but do not receive a current while *e* of Q and *b* of H are in contact, but immediately they are separated the line is connected to *f* of Q and *a* of H, and they receive a current. Now, as both Z and Z′ and W and W′ are connected at the same time with the splits, it would seem that the waves would mix; but this is not the case, as the forks Q and K make twice as many vibrations per second as P or H. Hence, when both Z Z′ and X X′ at both ends are in connection with the splits *z z z* and *x x x*, these splits do not receive the line simultaneously—first one split receives a wave, immediately afterward the other split receives a wave. Thus a wave passes through the line and signaling-instruments Z and Z′, while no other instruments are receiving it. Immediately after another wave passes through X X′, and no other instrument receives it. Now, when the prongs of P and H pass to the opposite points, connected to W and Y, it is obvious *z* and *y* cannot receive a wave, while W and W′ will receive a wave, immediately followed by a wave, *y y*′. Thus the line is first connected to Z and Z′, then to X and X′, then to Y and Y′, and, lastly, to W and W′, and so on, and, if the time of the various contact-points, as well as the forks, is the same, four series of waves, when all the keys are closed, will be sent over the wires, and each series will pass through its particular instrument, and through none other, and these waves, producing sufficient magnetism in the cores of the relay-magnet, cause it to close, and when one key is opened one series of waves is dropped out, and does not go over the wires, and the corresponding instrument at the distant station will receive no

waves or electricity whatever. Hence its lever will be withdrawn from the face of the magnet by its retractile spring, and again attracted by closing the key and allowing the dropped series of waves to again pass over the line, and between each series of waves so sent the wire will be put to earth at both ends, and at several points along such wire way-stations are inserted immediately after the cessation of one set of waves and before another commences, thus allowing the wire to discharge its static inductive current, and prevent a mutilation of the signals.

I do not wish to confine myself to any particular form of signaling-instrument, as either magnetical or chemical may be used. Polarized relays may be substituted for common relays, and the keys arranged to transmit reverse currents. Neither do I wish to confine myself to any particular shape of tuning-fork, or arrangement of contact-points, or method of keeping it in motion to accomplish this object, as innumerable combinations may be made by persons skilled in the art. Neither do I wish to confine myself to any particular method of signaling over the controlling-circuit without affecting the forks A and L, as the same may be duplexed, or the forks worked by a rise and fall of tension, and signaling done by reversing the direction of the current, and in various other ways. Neither do I wish to confine myself to any particular method of putting the line to earth between each series of waves, as this can obviously be done in many ways—as for instance, connecting the line to earth at each end before it enters the forks by a resistance-coil, the resistance of the same being made as low as will admit of, and still allow signaling. Neither do I wish to limit myself to the creation of four signaling-circuits, as a multiple fork, making twice as many vibrations as K and Q may have the line pass to it first; thence to K; then by the combination of two forks like H, one with the wires leading to Z′ Y′, and the other with the wires leading to X′ W′.

Eight series of waves may be made to pass over the wire, each series of which passes through its particular signaling-instrument and no other, the limit of subdivision being only a question of battery-power, delicacy of signaling-instruments, and accuracy of adjustment.

I will here mention that if ordinary relays are to be used they should be shunted, so as to cause their self-induction to circulate within its own wire, making the current more even for signaling.

I will also mention that several sets of transfer-forks may be included in the same local circuits at all the stations, and worked by the reeds or forks of the controlling-line, thus enabling me to split several lines in the manner described, by the use of only one controlling-line.

Of course, the same object would be attained by using several contact-points and local circuits.

I claim as my invention—

1. The method, substantially as herein described, of subdividing a single telegraphic circuit into two or more independent signaling-circuits by means of vibrating tuning-forks or reeds.

2. The method, substantially as herein described, of subdividing a single telegraphic circuit into two or more independent signaling-circuits by means of vibrating tuning forks or reeds kept in continuous vibration by electro-magnetism.

3. The method, substantially as herein described, of subdividing a single telegraphic circuit into four or more independent signaling-circuits by means of a primary or fundamental fork or reed, and one or more auxiliary forks or reeds, which latter are in respect to the number of their vibrations submultiples of the primary fork or reed.

4. The method, substantially as herein described, of subdividing a single telegraphic circuit into a number of separate signaling-circuits by means of one or more sets of electro-magnetic tuning forks or reeds, each set being composed of one or more forks or reeds, when these are controlled and made to vibrate isochronously by means of a controlling electro-magnetic tuning fork or reed, placed in another and independent circuit.

5. The method, substantially as herein described, of connecting a telegraph-line to earth immediately after it is detached from one set of signaling-instruments, and of disconnecting it from the same before it is placed in connection with another set of instruments.

6. A telegraphic circuit, subdivided at each station into an equal number of independent branches, in combination with two or more isochronous tuning forks or reeds, when the latter are so arranged as to place the main line alternately or successively in simultaneous connection with each pair of branches, substantially as set forth.

7. A telegraphic circuit subdivided at each station into an equal number of independent branches, in combination with two or more isochronous tuning forks or reeds, and two or more sets of electro-magnets for keeping the said forks or reeds in continous vibration, when the latter are so arranged as to place the main line alternately or successively in simultaneous connection with each pair of branches, substantially as set forth.

8. A telegraphic circuit subdivided at each station into four or more branches or signaling-circuits, in combination with a primary turning fork or reed, kept in continuous vibration by the action of the electro-magnets, and one or more similarly-actuated auxiliary forks or reeds, which in respect to the number of their vibrations are submultiples of the primary fork or reed, substantially as set forth.

9. A telegraphic circuit, subdivided at each station into two or more branches or signaling-circuits, by means of vibrating tuning forks or reeds, in combination with another and independent circuit, in which are placed other electro-magnetic tuning forks or reeds, so arranged as to control and render isochronous the vibrations of the tuning forks or reeds at the different stations upon the first-named circuit.

10. The vibrating tuning fork or reed K, in combination with the contact-springs 13 15, contact-points *c* and *d*, and contact-screws 14 16, when so arranged that the line will be momentarily connected directly to the earth while the fork is passing its center of oscillation in either direction, substantially as set forth.

11. The combination of the transfer-reeds and their signaling-instruments, local circuit, and batteries with the main-line reed or reeds, substantially as and for the purpose set forth.

12. The tuning forks or reeds A and L, with their contact-springs, contact-points, and main battery, in combination with the signaling apparatus R and S, substantially as described, and for the purposes set forth.

13. The combination, in one and the same local circuit, of several set of transfer-forks at each of the different stations, substantially as and for the purposes set forth.

Signed by me this 16th day of August, A. D. 1876.

THOS. A. EDISON.

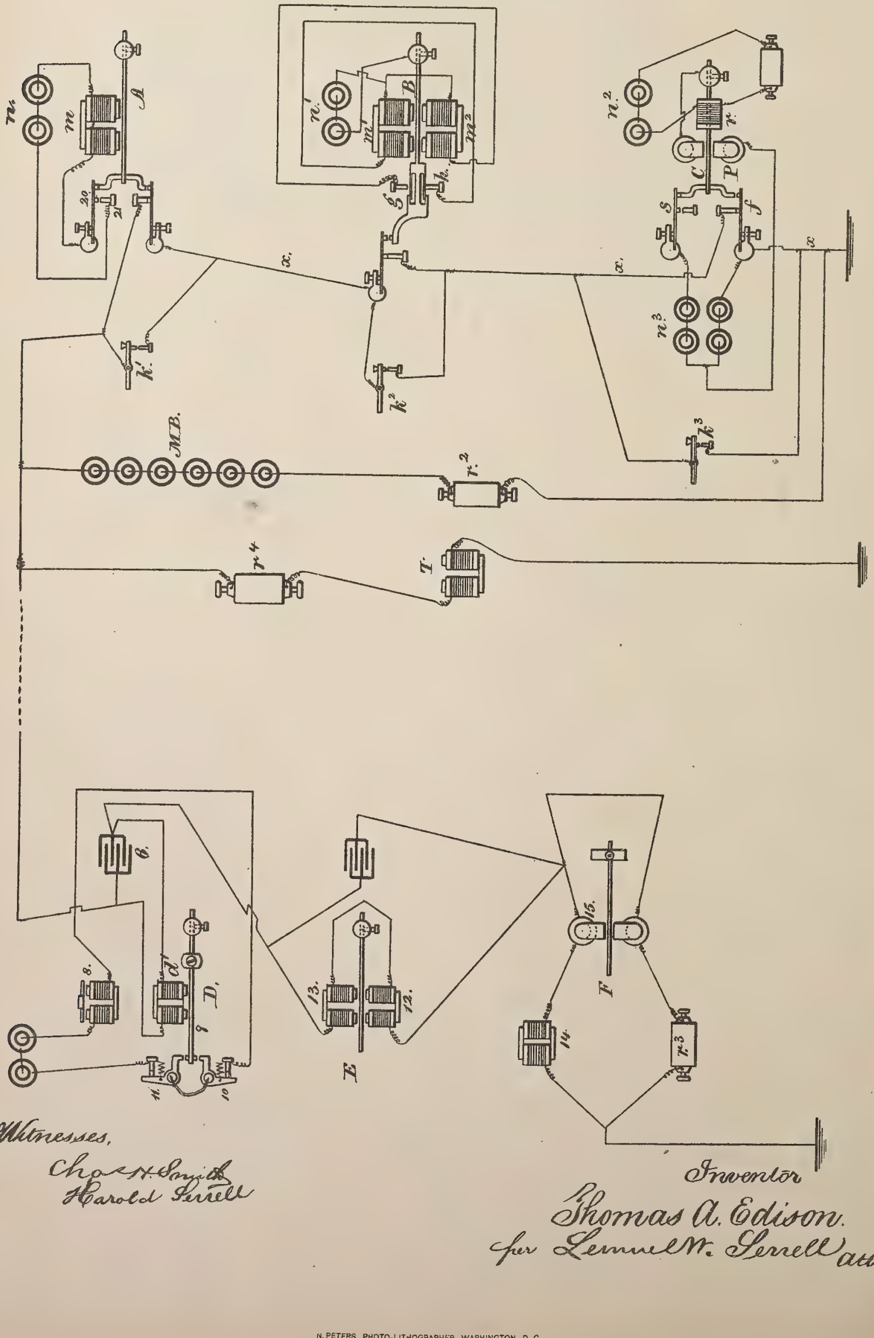
Witnesses:

GEO. D. WALKER,
GEO. T. PINCKNEY.

T. A. EDISON.

ACOUSTIC ELECTRIC TELEGRAPH.

No. 186,330. Patented Jan. 16, 1877.



Witnesses,
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison.
per Lemuel W. Serrell att'y

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON. D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN ACOUSTIC ELECTRIC TELEGRAPHS.

Specification forming part of Letters Patent No. **186,330**, dated January 16, 1877; application filed May 16, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

The object of this invention is to employ a main battery always in the close circuit of the main line, and to use a short-circuiting wire for that main battery, so arranged with reference to the vibrating reeds that the vibrations shall open and close the short-circuiting wire; hence, the main battery will send its pulsations on the main line when the short circuit is broken.

In the drawing, A, B, and C represent reeds that are vibrated by local circuits and electro-magnets, and they are of varying tones, so as to vibrate in different periods of time, and the vibrations of the reeds are made to open and close the local circuits. The reed A is provided with an electro-magnet, m, local circuit and battery n, and contact-points 20 21, that are opened as the reed is attracted by the electro-magnet; hence the vibrations will be continuous.

The reed B is between two magnets, m^1 m^2, and these are connected in local circuits from the battery n^1, and there are at opposite sides of the reed B the contact-points g h, and the wires are arranged so that when the reed closes against g the circuit passes through B from n^1, and by g through m^2 to n^1, attracting the reed from g, and when the reed closes against h the current is thrown through m^1. This insures uniformity in the vibrations of the reed as the powers operating are equal upon both sides of it, and the movement will be equal each way from a state of rest, regardless of the power of the battery. The reed C passes through the helix r, and hence it is magnetized by the current from a local battery, n^2. The reed C might be a permanent magnet; but I prefer to magnetize it by a helix. These are two lateral cores from the electro-magnet P, at opposite sides of the reed C, and the battery n^3 is connected to the circuit-closing points f s, between which is the reed c, the middle of the battery connected to the magnet P, and thence to the reed C. By this arrangement of circuits the current through P will be in first one direction and then the other, and the polarity of the cores alternately changed to act by attraction and repulsion equally, first one way and then the other upon the reed. This causes the vibrations of the reed to be very regular and uniform, and prevents sluggishness by residual magnetism.

The keys k^1, k^2, and k^3 are in branch wires of the short-circuiting wire x, and the normal position of these keys is open, and as the wire x would short-circuit the main battery M B, if the contact-points of the respective reeds were all closed there would not be any current sent upon the line; but a pulsation will be sent for each break made in the short-circuiting wire x; hence, the pulsations will pass over the line-wire according to the times of vibration of the various reeds. Whichever key k^1, k^2, or k^3 is closed the corresponding reed A, B, or C will cease to send waves upon the line, as its contact-points will be short-circuited, and hence the corresponding reed, at the distant station, will come to a state of rest and close their local circuits, or otherwise produce the given signal.

The rheostat r 2 is introduced to form a resistance in the short circuit and to lessen the sparks at the contact-points. The rheostat r 4 and electro-magnet T are introduced in a branch from the main line to the earth, either at the transmitting or receiving station to allow a portion of the current to pass to earth, and by the discharge of the electro-magnet to set up a counter-current that neutralizes the static charge of the line.

The receiving-instrument D is provided with the reed 9, that is vibrated by the electro-magnet d' in the main line, and there is a shunt-circuit containing a condenser, 6, which serves to neutralize the effect of the self-induction in the magnet, and to lessen the risk of the reed being affected by the currents that pass through the magnet, and pulsate at a different rate to the vibrations of this reed 9.

I find in practice that in an acoustic telegraph a condenser acts, in connection with the magnet, to increase the length of vibration of the reed, while under similar circum-

stances a condenser used with an ordinary sounder causes it to stick and have a tardy movement.

The levers 10 and 11 are applied at opposite sides of the vibrating end of the reed, and increase the motion at the contact-points, which close and open the local circuit to the relay or sounder magnet 8.

The reed E is between the cores of the electro-magnets 12 and 13, and the helices of these magnets are both in the main-line circuit. The cores of one of these magnets is covered with a metallic tube, which causes a circulation of the self-induction currents of the magnet, and prevents the rapid demagnetization of the cores. This produces in the magnet 12, containing such tube, nearly a constant attractive force, and in the other magnet 13 will receive clear sharp impulses. This construction is advantageous, because the electro-magnet 12 is a constant attractive force, that prevents the reed responding to pulsations in 13 that do not correspond with its time of vibration.

The polarized reed F is between the two projections of the magnet 15, and 14 is an electro-magnet with its armature in contact with its cores, and this magnet is in the branch wire running through one of the spools of the magnet 15, and in the other branch wire passing through the other spools is a rheostat, r^3. The current from the distant station produces no direct effect in 15, but the induced current set up in the magnet 14, reacting through the magnet 15, produces vibrations of the reed when those pulsations harmonize with its period of vibration.

I claim as my invention—

1. The main battery M B, and short-circuiting connection x, both between the line and the earth, in combination with a series of reeds or vibrating transmitting-instruments and contact-points opened and closed by the reeds, substantially as set forth.

2. The magnets m^1 m^2, vibrating reed B, circuit-closers g and h, local battery n', and connections, arranged substantially as set forth, whereby the circuits, through the respective magnets, are entirely broken alternately by the vibration of the reed, as specified.

3. The combination, with a polarized vibrating reed, of an electro-magnet and circuits, substantially as set forth, whereby currents of alternating polarity are passed through the electro-magnet by the circuit-closers that are operated by the reed, substantially as set forth.

4. The combination, with the main battery and shunt between the line and earth, reeds, and contact-points, operated by such reeds, of finger-keys placed in short circuits around the circuit-closing points, substantially as set forth.

5. In an acoustic telegraph receiving-instrument, the combination, with the receiving-magnet, of a condenser, in a shunt around such magnet, substantially as set forth.

6. The combination, with the reed 9, of the levers 10 and 11, contact-points, local circuit, and receiving magnet or sounder 8, substantially as set forth.

7. The magnets 12 and 13, at opposite sides of the vibrating reed, and in the main-line circuit, with tubes around the cores of one of the magnets, for the purposes set forth.

8. The magnet 15, with its cores in branches of the main line, in combination with the polarized reed induction-magnet 14, and resistance R^3, substantially as set forth.

Signed by me this 9th day of May, A. D. 1876.

THOS. A. EDISON.

Witnesses:
J. D. RUSS,
CHAS. BATCHELOR.

2 Sheets—Sheet 1.

T. A. EDISON.

TELEGRAPHIC ALARM AND SIGNAL APPARATUS.

No. 186,548. Patented Jan. 23, 1877.

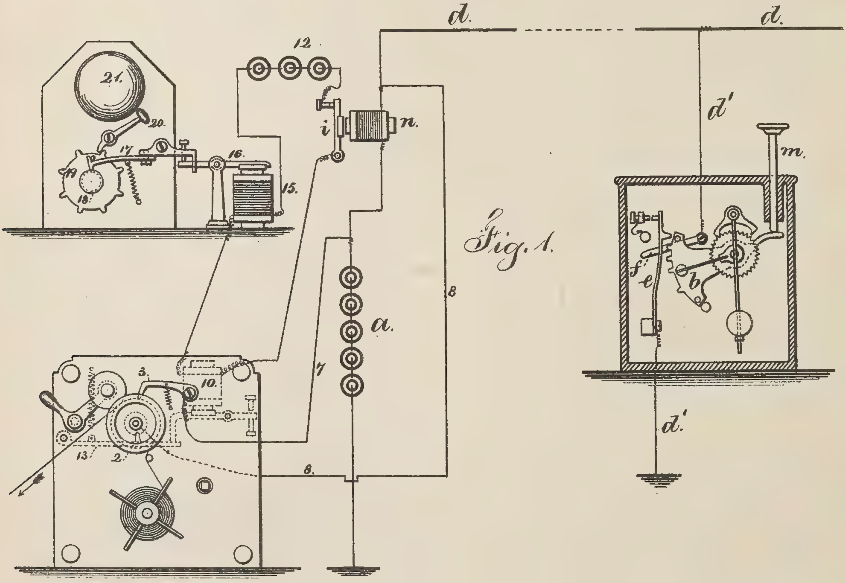
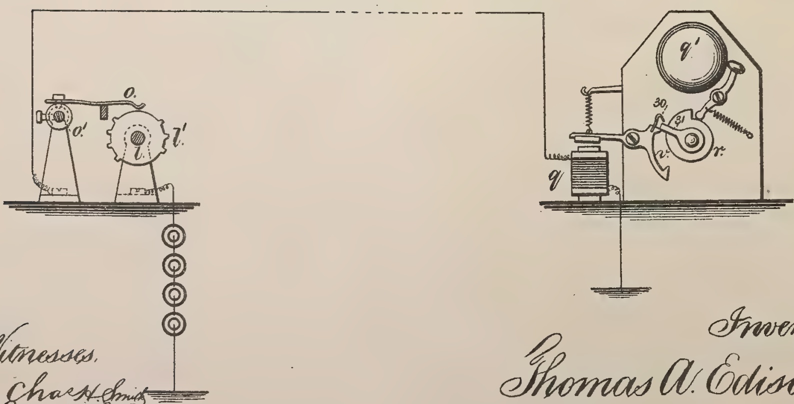


Fig. 1.

Fig. 2.



Witnesses.
Chas H. Smith
Harold Serrell

Inventor.
Thomas A. Edison.
per Lemuel W. Serrell.
atty

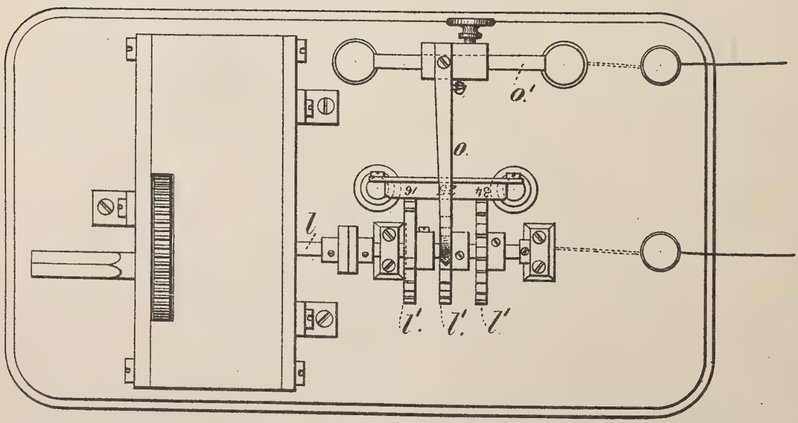
2 Sheets—Sheet 2.

T. A. EDISON.

TELEGRAPHIC ALARM AND SIGNAL APPARATUS.

No. 186,548. Patented Jan. 23, 1877.

Fig. 3.



Witnesses

Chas H. Smith

D. P. Cowl.

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE DOMESTIC TELEGRAPH COMPANY, OF NEW YORK.

IMPROVEMENT IN TELEGRAPHIC ALARM AND SIGNAL APPARATUS.

Specification forming part of Letters Patent No. **186,548**, dated January 23, 1877; application filed May 18, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in District and Fire-Alarm Telegraphs, of which the following is a specification:

The object of this invention is to provide a cheap and reliable alarm, adapted to small cities and towns, for giving fire-alarms or other signals.

I make use of a central station, with one or more lines running to the respective signal-instruments, which may be similar to those shown in Letters Patent No. 169,972, and are placed in a branch running to earth. When the signal-instrument is operated an alarm is given at the central station to call attention, a record is made of the signal upon chemical paper, and the operator, by a revolving circuit-breaker, rings a bell or bells in the engine-house, or wherever the alarm has to be sounded, giving the location by the number of taps of the bell, to show where the fire is, or the call that requires to be answered.

In the drawing, Figure 1 is a diagram illustrating the circuit-connections from a central station to one distant signal-box; and Fig. 2 shows the circuits from the central station to the engine-house or other location to which the signal is to be sent; and Fig. 3 is a plan of the instrument employed to signal such engine-houses or other station.

The main battery a is connected to the earth and to the line-wire d, and from this one or more branches, d', pass to earth, and in each such branch there is a signaling-instrument, adapted to be operated for sending pulsations denoting numbers, and by operating this instrument the circuit is closed and again broken when the signal has been given. An instrument of this general character is shown in the Patent No. 169,972, with the exception that the segment b has teeth upon it that operate the circuit-closing spring e, and when the segment is being turned by pushing in the rod m the switch f is moved to close the branch circuit to the spring e, and when the segment falls again, giving the pulsations through the circuit-closer e, the switch f is moved back during the latter part of the movement of b and breaks the circuit of e, so that one set of signals only will be given. The signal is received at the central station on chemical paper, the circuit passing, by 7, from the main line through the stylus 3, and drum 2, and back, by 8, to the line at the other side of the electro-magnet n. By this arrangement the resistance of n causes a portion of the current to pass through the chemical paper, and the discharge from the said magnet n, when the circuit is broken, sets up a current of opposite polarity, to render the marks on the chemical paper sharp and distinct. The chemically-prepared paper is on a reel, which may be placed in a case, so as to keep it moist. The electro-magnet n operates an armature, i, that is in a local circuit from the battery 12, and in this is an electro-magnet, 10, that operates the trip 13 of the clock-work used to revolve the drum 2 and move the chemical paper, so that as soon as the circuit of n is closed and its armature attracted the local circuit from 12 is broken, the armature of 10 falls back and releases the trip or stop of the clock-work, and the paper is moved by the drum to receive and record the pulsations of the signal. The magnet 15 in the circuit from 12 operates the trembler 16, which is an armature-lever acting upon a dog, 17, in the screw 18 upon the shaft of spur-wheel 19, operating the hammer 20 of a bell, 21. The wheel 19 and screw 18 are revolved by clock-work for ringing the bell, and this ringing will continue until the circuit through 15 remains closed long enough to allow the screw to move the dog 17 endwise of the screw until it arrests by a stop the movement of the clock-work. The alarm-bell 21 is rung, as aforesaid, as soon as the circuit of d is closed, at the distant station, so as to call the attention of the attendant to the message received upon the chemical paper.

At the central station the attendant has a clock-movement with a shaft, l, upon which are break-wheels l', with conducting peripheral projections, and there are as many break-wheels as there are signal-stations or characters of signals to be received at the central office. There is also a contact-spring, o, adjustable upon a rod, o', so that it may be moved along to come in contact with either of the break-

wheels. As soon as a signal is received the attendant moves the spring *o* along into contact with the wheel corresponding to the signal received. A battery is in circuit with this wheel *l′*, and the spring *o* leads to the line-wire that runs to an engine-house or other place where the signal is to be given, and there energizes the electro-magnet *q* and gives pulsations or taps upon a bell, *q′*, corresponding, as to length of duration and intermediate pauses, with the break-wheel *l′*, with which the spring *o* is in contact. I prefer and use a cam, *r*, that is revolved by clock-work and moves the bell-hammer, and the escapement *v* controls the revolution of this cam, such escapement being connected with the armature of the electro-magnet, and having a spring-finger, 30, at one end to arrest the arm 31 on the cam-shaft, and thereby prevent a sudden stoppage of the momentum of the cam and gearing. This spring yields as the arm passes it, so as to prevent concussion or rebound, and as the pallets of the escapement are moved by the electro-magnets the cam of the bell is allowed to revolve and ring the bell, giving the proper number of taps, according to the number of the station from which the alarm proceeds.

The solution used for moistening the chemical paper is preferably composed of a solution of pyrogallic acid, chloride of sodium, or other conducting substance, and a salt of strontia.

I claim as my invention—

1. The segment *b*, with points upon its edge, in combination with the circuit-closing spring *e* and switch *f*, operated by the movement of the segment, as set forth.

2. The receiving-instrument, provided with a trip for the actuating-gearing, in combination with the electro-magnet to move the trip and the roller 2 and stylus 3, substantially as set forth.

3. The local circuit electro-magnets *n* and 15, in combination with the call-bell 21, trembler 16, and chemical recording-instrument, substantially as set forth.

4. The transmitting-instrument, provided with a revolving shaft and circuit-closing wheels corresponding to the signals of the various signaling-instruments, and a movable contact-spring, arranged and operating substantially as set forth.

5. The bell signaling-instrument, constructed with a revolving cam to operate the hammer, a spring-stop upon the escapement, and an electro-magnet to operate the escapement, substantially as set forth.

Signed by me this 9th day of May, A. D. 1876.

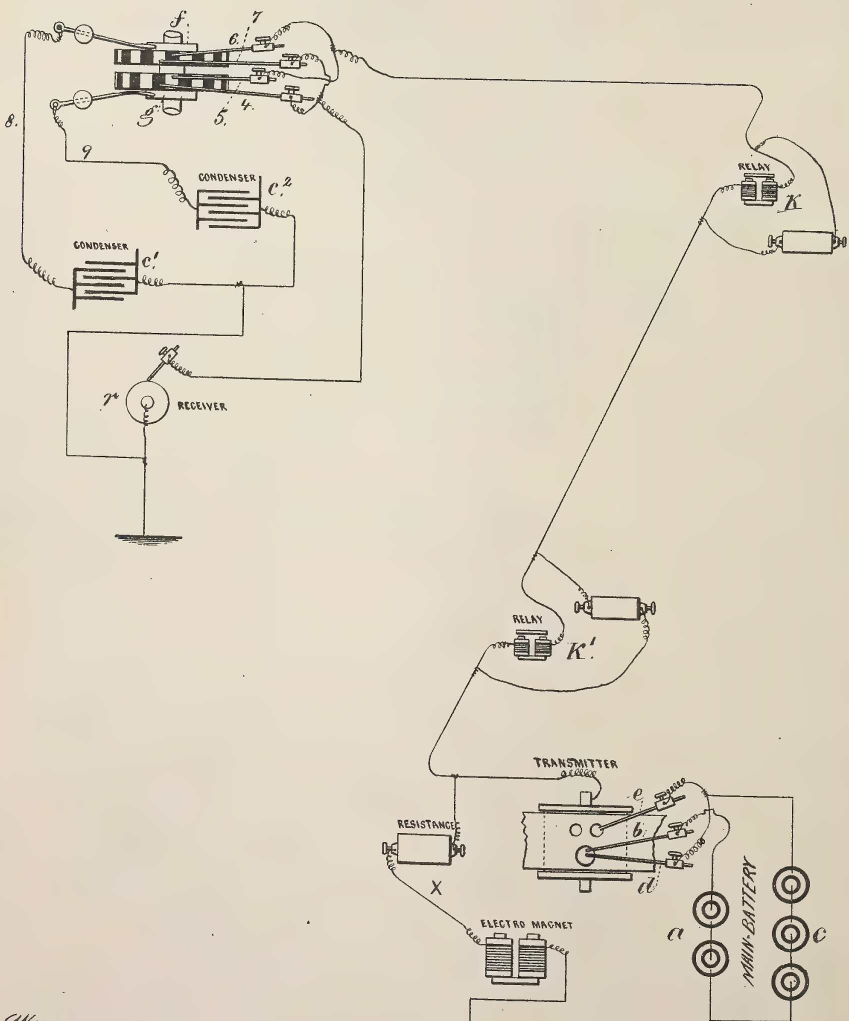
THOS. A. EDISON.

Witnesses:
J. D. RUSS,
CHAS. BATCHELOR.

T. A. EDISON.

AUTOMATIC TELEGRAPH.

No. 195,751. Patented Oct. 2, 1877



Witnesses

Chas H. Smith

Geo. T. Pinckney

Inventor

Thos. A. Edison

per L. W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **195,751**, dated October 2, 1877; application filed January 27, 1875.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphs, of which the following is a specification:

This invention is for bringing into operation condensers by alternately connecting and disconnecting them from the line by revolving wheels having alternate conducting and non-conducting surfaces.

In the accompanying diagram the improvement is illustrated.

At the sending-instrument the battery is divided, the part *a* being connected to the stylus *b*, and the part *c* to the stylus *d* and *e*, and these are so arranged for the purpose of weakening the middle portion of the dash, because the stylus *b* drops into the large perforations for a dash near the edge of that perforation, and remains a less time than the stylus *d*, and at that time throws into action a local circuit from the smaller battery *a*, that is opposed to that of the main battery *c*, and thus lessens the current in the middle of each dash-mark.

X is an ordinary branch circuit at the sending end for the static discharge from the line.

K K′ are signaling Morse relays used along the line. The helices of these relays are not to exceed one inch in length, and the coils are shunted with a resistance equal, or nearly so, to the resistance of the coils on said relays, so as to provide a route for the induction set up in the coils to circulate without going out upon the line to mutilate the signals.

The natural effect of this induction-current circulating within this circuit is to make the relay stick; but I have found that by decreasing the length of the cores and coils, the induction is decreased to such an extent that this result does not follow.

Two wheels or surfaces with alternating conducting and non-conducting surfaces *f* and *g* are employed in connection with the circuit-closing springs or points 4 5 6 7, and these wheels are revolved rapidly when the instrument is in work.

The hubs of *f* and *g* are connected by the wires 8 and 9 with the condensers C^1 C^2. The springs 5 and 6 are connected with the line, and 7 and 4 to the receiving-instrument *r*.

The condensers C^1 C^2 are, by preference, condensers in air without intermediate sheets of paper.

The wheels *f g*, in the act of rotating, connect the condenser C^1 in the circuit of the line at the same moment that the condenser C^2 is connected to the receiving-instrument. This is then disconnected and connected to the line, and C^1 connected to the instrument.

In alternately throwing these condensers, first on the line and then on the chemical receiving-instrument, with great rapidity, signals made on the line at the distant station charge these condensers, and the condensers transfer these charges to the receiver without it having any connection whatever with the line.

As the condensers can be made to hold these charges for a length of time, it follows that by this method currents sent on one line may be transferred by condensers into another line, or to a short circuit containing a chemical receiving-instrument. By this means the static effects are nearly overcome, and perfect signals are recorded.

I do not wish to confine myself to any particular mechanism for operating the condensers; but

I claim as my invention—

1. The method herein specified of transferring the signals of one electric circuit into another circuit by revolving circuit-closing wheels with conducting and non-conducting surfaces and connections to condensers, and to the chemical recording-instrument, substantially as set forth.

2. The transmitting-instrument provided with a circuit-closing point and opposing battery for lessening the battery-power in the middle portion of the pulsation for a dash, as set forth.

Signed by me this 18th day of January, A. D. 1875.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
AUTOMATIC TELEGRAPH.

No. 195,752. Patented Oct. 2, 1877.

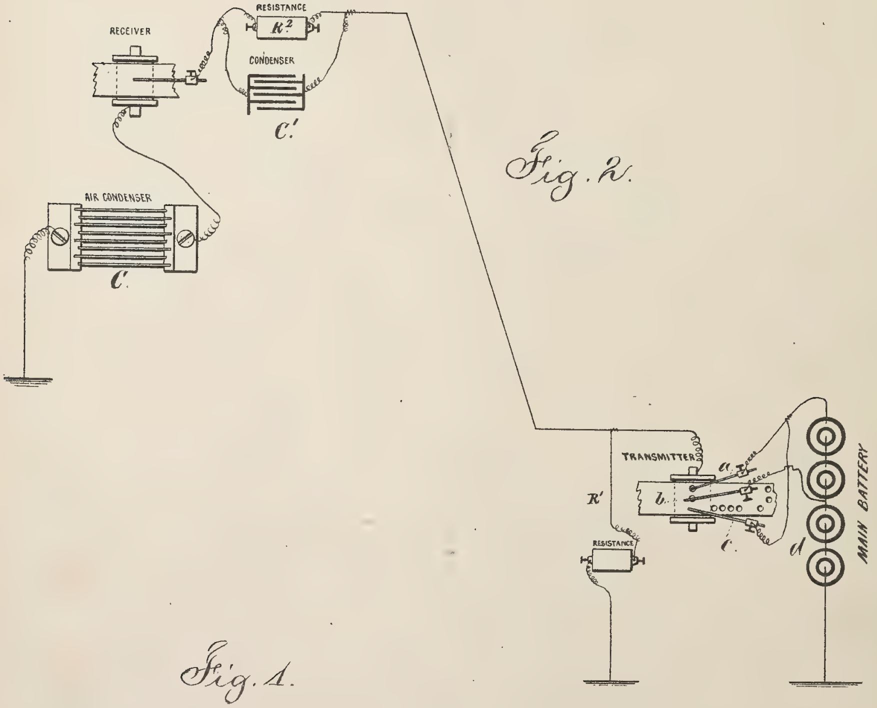
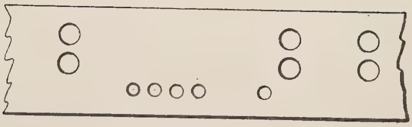


Fig. 2.

Fig. 1.



Witnesses;

Chas H Smith
Geo T. Pinckney

Inventor.

Thomas A. Edison.
per L. W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **195,752**, dated October 2, 1877; application filed January 27, 1875.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphs, of which the following is a specification:

The object of this invention is to transmit, over telegraphic circuits, dashes the first part of each of which is formed by a stronger current than the last, so as to prevent the wire from being fully charged statically; also, in arranging in the main line at the receiving-station a condenser formed of plates separated by air only.

The invention consists in the method of arranging the perforations and contact stylus or rollers to send a strong current by putting on the whole of the battery to form the first part of a dash, and immediately thereafter a second stylus closes the circuit through one of the holes intended for a dash, so as to preserve the continuity, but only to put on a portion of the battery.

Figure 1 shows the arrangement of perforations for the word "That," and Fig. 2 shows the arrangement of parts and connections.

The first stylus, *a*, passing into the first hole, closes the circuit, and puts the whole battery *d* upon the line. Just at the moment it is leaving this hole the middle stylus or pen *b* falls into the second hole, preserving the continuity of the circuit, but putting on only half of the battery. The third pen, *c*, puts on the whole of the battery, and forms the dots.

If the ends of the stylus or pens are in line, one perforation will be in advance of the next to form the dash; but if the point of one stylus is farther in advance than the next, the perforations may be in line with each other transversely of the strip, and two styluses in place of three might be similarly employed.

R^1 is a branch to earth for the static discharge of the line. C' is an ordinary condenser, shunted with a resistance, R^2, the object of which is to give a more powerful compensation should the air-condenser C prove insufficient; but generally the resistance R^2 is made *nil* or short-circuited, so that the condenser C' is dispensed with. The first portion of a signal coming over the wire records itself on the chemically-prepared paper, and at the same time charges the condenser C. Now, when the signal ceases, the condenser C discharges a contrary current, which balances that from the line.

The reason of sending a weaker current to form the last portion of a dash is to prevent the wire from being charged higher with a dash than a dot, thus preserving an evenness in the recorded dots and dashes which it is very hard to obtain on very long circuits.

I use an air-condenser, C, so that it will discharge instantly, which is not the case with condensing-surfaces separated with a non-conducting material, the phenomenon of absorption preventing their discharging quickly and reducing the speed.

I believe I am the first to discover that an air-condenser applied to a chemical telegraph will promote rapidity of operation at the receiving-instrument.

I claim as my invention—

1. The air-condenser inserted in the line at the receiving-station of a chemical telegraph, for the purposes set forth.

2. In a chemical telegraph, the method specified of forming dashes by transmitting, by means of perforated paper, a strong current followed by a weak current, substantially as set forth.

Signed by me this 19th day of January, A. D. 1875.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Stencil-Pen.

No. 196,747. Patented Nov. 6, 1877.

Fig. 1.

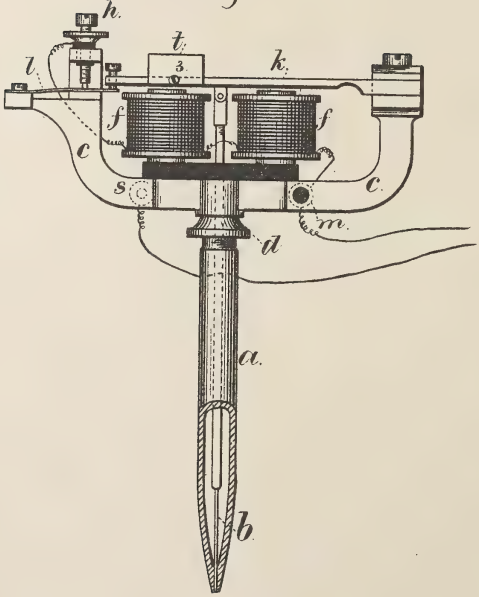
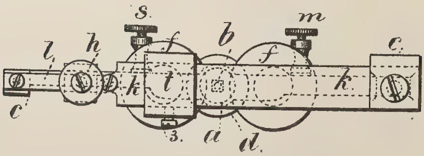


Fig. 2.



Witnesses

Chas. H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN STENCIL-PENS.

Specification forming part of Letters Patent No. **196,747**, dated November 6, 1877; application filed April 23, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Autographic Pens, of which the following is a specification:

My present invention relates to a pen actuated by electricity, and adapted to perforating paper that is to be used in printing in the manner set forth in Letters Patent No. 180,857, granted to me.

I reciprocate the perforating-needle with great rapidity by means of a reed or bar vibrating with great rapidity, and acting to open and close a circuit to an electro-magnet, that serves to maintain the vibration of the said reed or bar; and I employ an adjustable weight to vary the speed of vibration, similarly to a pendulum.

In the drawing, Figure 1 is a side view of the pen, reed, and magnet; and Fig. 2 is a plan of the same.

The tubular pen *a* and reciprocating needle *b* are similar to those in the aforesaid patent; and the tube *a* screws into the frame *c*, and it is clamped by the lock-nut *d* after the tube has been adjusted to the proper position relatively to the point of the needle.

Upon the frame *c* is an electro-magnet, *f*, the helix of which is connected at one end to the insulated adjusting-screw *h*, and at the other end to the insulated binding-screw *m*.

The reed *k* is secured at one end to the frame *c*, and the other end is free to act upon the spring *l*, and open and close the circuit between said spring *l* and the adjusting-screw *h*.

As the reed vibrates it opens and closes the circuit through the magnet. When the reed is attracted the circuit is broken, and as it flies back the circuit is again closed through the binder *m*, helix *f*, screw *h*, spring *l*, and frame to the binding-screw *s*, the flexible battery-wires being connected to these binding-screws *h* and *s*, as in aforesaid patent.

By this construction the speed of vibration will depend on the tone of the reed, and that may be altered and the vibration lessened or increased by moving the weight *t* along upon the reed and then clamping it by the screw 3.

When the weight is moved toward the point of attachment of the reed, the reed will be free to vibrate; but when moved toward the moving end of the reed the speed of motion will be lessened.

The upper end of the needle-rod is connected to this reed; hence motion of the reed is given to the rod and needle to actuate the same in perforating the paper.

The reed might be dispensed with, and a pivoted lever and spring be employed; but the speed and reliability are not as great as with the reed.

I claim as my invention—

The combination, with the electro-magnet and reed or lever vibrated by the same, of the perforating-needle, tubular pen, and circuit-breaker operated by the reed or lever, substantially as set forth.

Signed by me this 18th day of April, A. D. 1877.

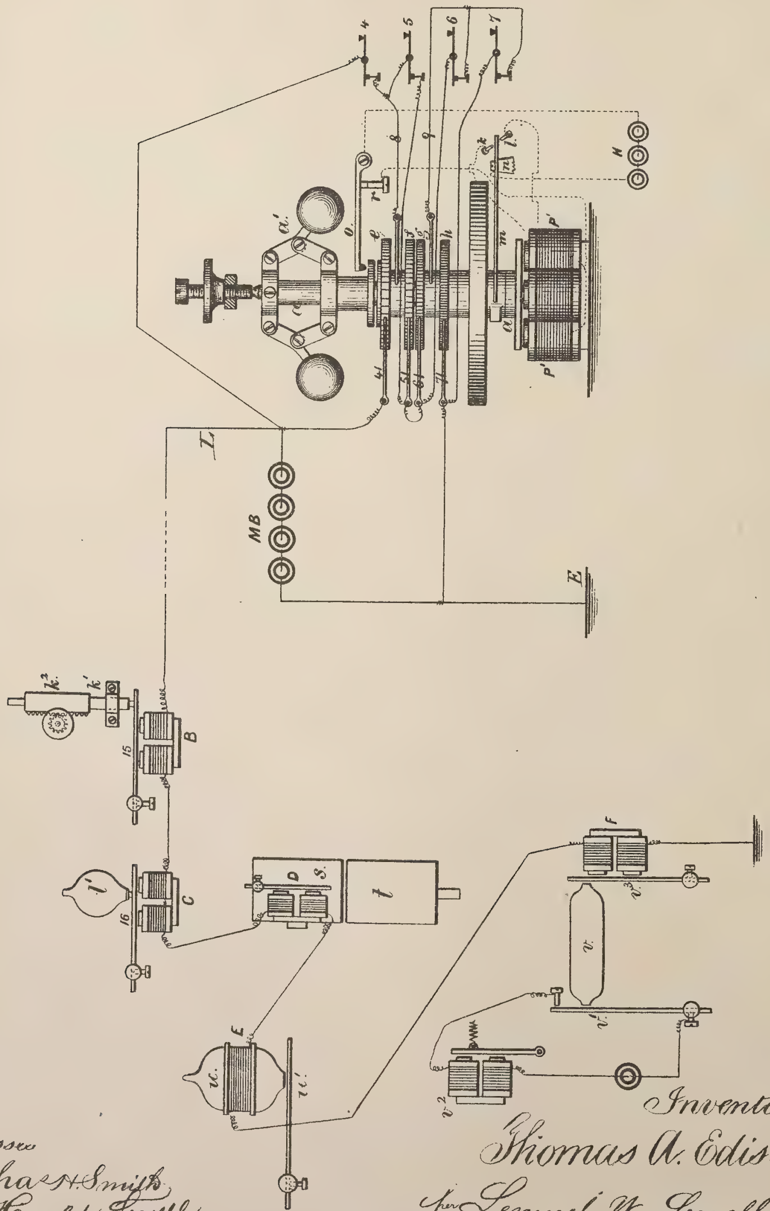
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Telephonic Telegraph.

No. 198,087. Patented Dec. 11, 1877.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison

per Lemuel W. Serrell

Atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN TELEPHONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **198,087**, dated December 11, 1877; application filed May 16, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

This invention relates to a series of revolving circuit-closing break-wheels with varying contact teeth and notches, so that each wheel produces a different number of pulsations per minute from the others, in combination with finger-keys and an arrangement of circuits in which the main battery remains in the circuit of the earth and line, and is caused to produce pulsations by being short-circuited through the break-wheels.

It also relates to an arrangement of finger-keys, in combination with the battery in the main line and the break-wheels, whereby, when all the keys are closed, the battery is short-circuited, and the revolving break-wheels are inefficient, and do not transmit waves over the wire; but when either key is opened the short circuit is made to pass through the articular break-wheel connected to the key, and the pulsations are transmitted over the main line; also to an electro-magnet, vibrating reed, and sounding-box or resonator of corresponding pitch, forming a receiving instrument; also, the combination therewith of a local circuit-breaking apparatus actuated by the vibrations of a column of air.

In the drawings, the improvement is shown by a diagram of the apparatus and the circuits.

The shaft *a* is driven by any desired power. I have shown the same as actuated by an electric engine, P′ P′, and battery H, and the lever *m* upon the standard *n* is moved by two cams upon the shaft *a*, and the spring end of the lever is between the circuit-closing points *k l*, the point *k* being connected in the circuit through one pair of magnets, and the point *l* being connected in the circuit through the other pair of magnets, so that the revolution is produced by the lever *m* closing the circuit through the electro-magnets alternately as the revolving armature is approaching the cores of such magnets.

The governor *a′* is upon and revolved by the shaft *a*, and *o* is a lever insulated from contact with the governor or shaft, but acting to close the circuit to the motor through contact-points *r*; hence the speed of the engine will be regulated accurately, for when the velocity increases sufficiently to separate *o* and *r*, the circuit to the engine will be broken and the reverse; hence the circuit will be closed through *o* and *r*, delicately, according to the speed.

The circuit closing or break wheels *e* and *f* are connected, and also *g* and *h*, but they are insulated from the shaft *a*; the circuit-closing springs 41 51 61 71 are provided for these wheels respectively, and they are connected to the finger-keys 4, 5, 6, and 7, respectively, and the conductors 8 and 9 are in contact with the respective pairs of break-wheels. The keys and break-wheels are in a short or derived circuit connecting from the line L to the earth E, to short-circuit the main battery.

Premising that the teeth of the respective break-wheels *e f g h* are at different distances, so that electric pulsations from each wheel will be different in number per minute from the pulsations of the other wheels, I remark that when all the keys 4 5 6 7 are closed the circuit from the line to earth is closed independent of the break-wheels *e f g h*; hence the battery M B will be short-circuited; but if the key 4 is opened the short circuit is only closed through 41, *e*, and 8; and hence the break-wheel *e* will alternately short-circuit the battery M B, and allow the same to charge the line, and there will be as many electric pulsations sent upon the line, at the speed of the circuit-breaker *e*, as there are contact-points passing while the key 4 is open.

If the key 5 is opened, the short circuit of the battery is, by 4 8 *f* 51 6 7, to earth, the break-wheel *f* and spring 51 giving the pulsations. If the key 6 is open, the circuit will be by 4 5 61 *g* 9 7, to earth, and the pulsations will be by the break-wheel *g* and spring 61. If the key 7 is open, the circuit will be by 4 5 6 9 *h* 71 to earth, the pulsations being by break-wheel *h* and spring 71.

By this arrangement each break-wheel is

brought into action by opening the corresponding key, and two or more break-wheels can be brought into action without either one preventing the action of the others, so that if all the keys should be opened simultaneously all the break will be operative, the short circuit being 41, *e*, *f*, 51, 61, *g*, *h*, and 71.

At the receiving-station, the main circuit from the line passes through the helices B C D E F of the respective electro-magnets, and in front of the magnets B and C are reeds 15 and 16, of a tone to vibrate by pulsations of the speed sent from two of the transmitting instruments. The reed 15 is in front of the telescopic-tube resonator, that is made of tubes k^1 k^2, one of which is movable by rack and pinion, or otherwise, so as to vary the length and quickly adjust the same to the tone of the reed or to the pitch required for the pulsations that are being sent. This allows for adjusting the reed itself, or for adjusting a vibrating body that is moved by the electro-magnet, whether the same is toned or not.

This sounding-box or resonator, being adjustable, accommodates the receiving-instrument to variations in the pulsations that may result from inaccuracy in the speed of the transmitting-instrument.

The reed 16, or its equivalent, is made with a valve at the mouth of the resonator l', so that the atmosphere therein will be vibrated by the corresponding pulsations acting in the electro-magnet, and from these resonators the signal may be ascertained by the ear applied to their small tubes.

The sounding-box *s* has upon it the magnet D and a reed or other vibrating body. The box is of such length as to respond to the vibrations of a certain pitch, and in front of the box *s* is a sounder-box, *t*, by which the column of air can be regulated and extraneous sounds kept from the box.

The Helmholz resonator *u* is made of a hollow iron shell, with fine wire wound around it, forming the helix E, through which the current passes.

The shell of the resonator becomes a magnetized core, and attracts the reed u', causing the same to vibrate in front of it, and by the expansion and contraction the air within is set in powerful vibration. The reed *u* may be made to operate a local circuit or to give the indication by sound.

The electro-magnet F, with a reed, v^3, toned to the proper pitch, is used in connection with the air-tube *v*, that is a resonator of the proper pitch corresponding to the reed.

A delicate contact-spring, v^1, is applied at the opposite open end to the reed v^3. It is preferably toned to the same pitch as the tube *v* and reed v^3, and vibrates by the action of the air in *v*.

The sounder v^2 is in a local circuit, of which the reed or spring v^1 forms a part; hence the sounder responds to the vibrations of the reed v^3.

I do not claim a series of wheels revolved by mechanism and transmitting pulsations corresponding in time to vibrations of an acoustic receiving-reed.

I claim as my invention—

1. A telegraphic circuit and battery, a series of revolving break-wheels, and a series of finger-keys, arranged in a derived circuit between the line and the earth, substantially as set forth, whereby the revolving break-wheels are short-circuited through the finger-keys, substantially as specified.

2. The combination, in a telegraph, of an electro-magnet, a sounding box or tube containing a column of air, and a reed acting as a valve at the mouth of the tube, so that the column of air is vibrated by pulsations in the electro-magnet, substantially as set forth.

3. An iron resonant tube or sphere, surrounded with a wire helix, and included in a telegraphic circuit, substantially as set forth.

4. The combination of an electro-magnet, vibrating reed, sounding-box or resonator of corresponding pitch, and a local circuit-breaking apparatus, actuated by the vibrations of a column of air in said resonator, substantially as set forth.

Signed by me this 9th day of May, 1876.

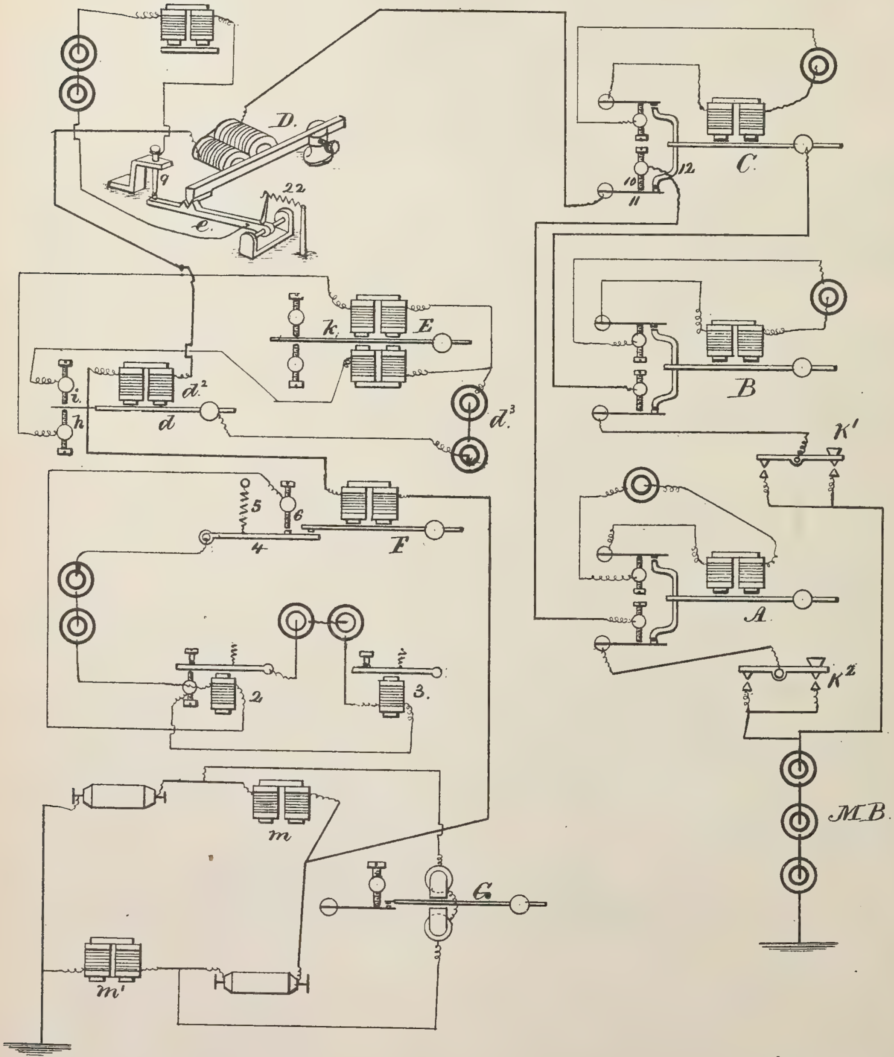
THOS. A. EDISON.

Witnesses:
J. D. RUSS,
CHAS. BATCHELOR.

T. A. EDISON.

Telephonic Telegraph.

No. 198,088 Patented Dec. 11, 1877.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

Atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN TELEPHONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **198,088**, dated December 11, 1877; application filed April 6, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

I make use of two or more reeds, vibrating automatically and continuously, preferably by a local-circuit electro-magnet and circuit-breaker operated by the reeds; and these are connected to a circuit-changer placed between them and the main line, and operating to allow the vibrations from only one of the reeds at a time to pass upon the line. This circuit-changer is operated with a speed much greater than that of either of the keys, but at a less speed than either of the transmitting-reeds, so that the pulsations from either of the reeds can be thrown upon the line by the finger-key; but the pulsations from two reeds will not be sent upon the line by the circuit-changer at the same time, so that the pulsations at the distant receiving-station will be more distinct.

A, B, and C are transmitting-reeds. The reed A is placed in one branch leading from the battery M B, while B is placed in another branch. The reed C is in the circuit from the instrument B, between that and the main line.

The reeds A and B transmit waves by just opening the circuit, while the reed C alternately throws the waves from B and A into the main line. Reed C makes but a few vibrations per minute, and it prevents the transmission of both series of waves over the wire at the same time. First, a series of waves is sent from A through 10 and 11; then A is disconnected by 10 and 11 being separated, and a series of waves are sent from B, through C, 12, and 11; but owing to the rapidity with which the two series of waves are alternated into the line by the vibration of the reed C, the break in the continuity of each series is scarcely felt on the receiving-reeds.

It is obvious that several branches might be used, in each of which is placed a reed of different vibrating times, and each reed transmitting waves by simply closing the circuit, (just the opposite to the reeds A and B, which open the circuit,) and a circuit-changing device, operated by C, made to throw in and out of the main circuit each reed in succession, thus preventing the transmitting of but one series of waves over the wire at the same time, and thereby preserving an even adjustment of the receiving-reeds.

It is not necessary that the reed C should always have a constancy of vibrating time, as it is used solely as a circuit-changer; hence an electric engine may be used, its shaft provided with a break-wheel and contact-points, whereby any number of vibrations or waves from different reeds may be allowed to pass into the line.

K^1 and K^2 are keys used for the purpose of signaling by allowing or preventing the transmission of the waves.

D is a receiving-reed actuated by an electro-magnet, and it is set in motion by waves coming over the wire periodic with its vibrating time.

The extreme end of the reed is provided with a beveled edge, passing into but not touching a V-recess in the local-circuit-closing lever *e*, which lever is provided with a platina point upon its end, which remains in contact with the screw 9, by the action of the spring 22, when the reed is not vibrating; but when the reed commences to vibrate, its beveled end strikes both sides of the V on the lever *e*, and keeps the lever from remaining in contact with 9 long enough to close the local circuit, in which I place a sounder and local battery, in the usual manner.

The object of the double V is to cause the lever to receive a great number of vibrations, and causing the local circuit to be broken a great number of times, thus allowing the use of reeds having a low rate of vibration.

The form of reed shown at E is adapted to vibrate by waves from one of the transmitting-instruments.

The sounder consists of a reed, instead of those constructed in the ordinary manner.

d is the main-line reed, operated by the magnet d^2 in the main-line circuit. *h* and *i* are two contact-points, one connected to one pair of magnets on the local reed K, and the other point to the other pair of magnets. The

other two ends of the magnets are joined together, and connected to a local battery, d^3, and thence to the reed *d*.

When no vibrations having a periodic time with *d* pass over the wire, both *d* and *k* remain quiet; but if the operator at the transmitting-station causes the proper waves to be sent, *d* is set in motion. This reed, making contacts on *i* and *h*, causes the reed *k* to vibrate very powerfully, and, hitting its two limiting-screws, makes a sound equal to that of an ordinary sounder.

The advantage of this form of reed is, that it may be worked on very long circuits, and does not require very fine adjustment.

F represents a receiving-reed adapted to the tone and number of vibrations of the transmitting-instruments, and there is a local circuit, in which the lever 4 is kept in contact with its contact-screw 6 by the spring 5 when the reed is not vibrating. This closes the circuit of the repeating-sounder 2, which, in its turn, closes the receiving-sounder 3, the object of the intermediate or repeating sounder being to intercept any false dots, and prevent slight closing of the local from affecting the receiving-sounder 3.

When the proper waves are sent the amplitude of the reed F is sufficient to practically keep the lever 4 away from 6, thus opening both sounders; but if the waves are made to cease, the lever 4 comes in contact with 6, and closes the locals, and indicates the signal given.

G is a polarized reed, provided with a circuit-breaker like F. The reed is permanently magnetized, either by a coil and local battery or in the usual manner, and is adjusted equidistant from the two prongs of the magnet.

When the current passes in one direction through the magnet, one prong has a magnetism the same as that of the reed; hence no attraction takes place, while the other prong will receive a magnetism the opposite that of the reed; hence it will be attracted. If, now, the current be reversed, the opposite action takes place, and the reed is attracted by the other prong. This polarized reed is placed in the bridge-wire of a Wheatstone bridge, formed of two branch wires, each containing a magnet and resistance-coil. When a wave comes over the wire, none of this current passes through the bridge-wire containing G, but, acting on *m′* and *m*, causes them to set up secondary currents, and these currents, being set up within the bridge-wires, are not in balance; hence they will flow through the bridge-wire and actuate the magnet of G.

The moment the main wave ceases a reverse current from the magnets *m m′* will be sent through the bridge-wire to G. The magnets *m* and *m′* may be replaced by secondary batteries or by shunted condensers, or other devices for generating secondary currents.

I claim as my invention—

1. The combination of several acoustic instruments, each transmitting a different series of waves or impulses, with an automatic circuit-changer, whereby but one series of waves is allowed to pass over the wire at the same time, for the purpose set forth.

2. The combination of an acoustic main-line receiving-instrument, operated by a series of waves within a main circuit of another acoustic instrument, corresponding in its vibrating time, within a local circuit operated by the main-line instrument, substantially as set forth.

3. The combination, with an acoustic receiving-instrument, of a repeating-sounder for intercepting false signals, substantially as set forth.

4. The reed *d*, vibrated by a magnet in the main-line circuit, in combination with the reed *k*, local circuit, magnets, and contact-points *h i*, substantially as set forth.

5. The combination of a polarized acoustic receiving-instrument in the bridge-wire of a Wheatstone balance with induction devices in the line, substantially as and for the purposes set forth.

Signed by me this 3d day of April, A.D. 1876.

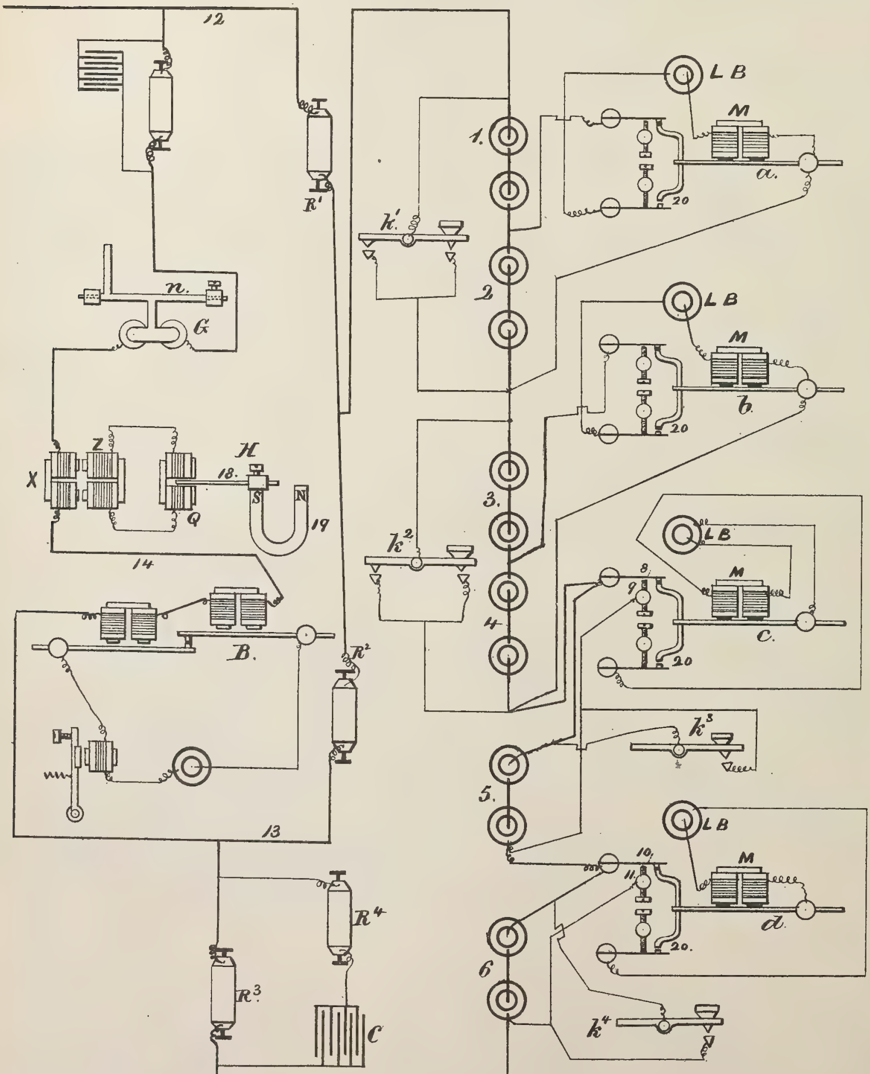
THOS. A. EDISON.

Witnesses:
HAROLD SERRELL,
CHAS. H. SMITH.

T. A. EDISON.

Telephonic or Electro Harmonic Telegraphs.

No. 198,089. Patented Dec. 11, 1877.



Witnesses,

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell att'y

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN TELEPHONIC OR ELECTRO-HARMONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **198,089**, dated December 11, 1877; application filed April 6, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

I make use of reeds vibrating in different periods of time. They are each kept in vibration automatically by a magnet and local circuit, and send pulsations corresponding in time upon the main line. The batteries are each placed in the main line, and arranged so as to oppose each other. The receiving-instruments are placed in the bridge of a Wheatstone bridge, and balanced in relation to the outgoing current, and respond to the current from the distant station; and the receiving-instruments are peculiarly constructed, so as to respond to the transmitted pulsations.

a, *b*, *c*, and *d* are the transmitting-reeds, each having a different vibrating time, and L B are the local batteries, and M the electro-magnets in the circuits of the respective batteries, by means of which the reeds are vibrated automatically, the local circuit at 20 being broken by the movement of the reed toward the magnet.

1 and 2 are batteries opposed to each other. The battery 2 is short-circuited by the contact-points upon the reed *a* at every vibration, thus allowing the battery 1 to transmit a short wave over the main wire to the distant station. K^1 is a key, which only allows these waves to pass over the wire at the moment when its lever is passing from the back to the front contact-point, and in contact with neither. These short waves cause the receiving-reeds to open and close the sounder for a very short period of time, and allowing the signals to be read by the contact of the lever of the sounder upon its lower contact only.

3 and 4 are another set of batteries, operated in the same manner as 1 and 2, except that the reed *b* makes a different number of vibrations per second than *a*.

c and *d* are two other reeds, each of which serves to break a short circuit around the batteries 5 and 6, thus allowing the current from 5 or 6 to pass over the line at the moment that 8 and 9 or 10 and 11 are separated from each other and the signaling-keys K^3 and K^4 are open.

R^1 R^2 and wires 12 and 13 form part of a Wheatstone balance.

14 is the bridge-wire, in which are placed the acoustic receiving-instruments G H B, operated by series of waves from the distant station. These reeds are in the bridge-wire, and the various resistance so adjusted that no currents from the batteries 1, 2, 3, 4, 5, and 6 pass through these instruments, but pass to the distant station to similar instruments in a bridge-wire of a Wheatstone balance.

R^3 is a resistance to balance the resistance of the line. R^4 is a resistance for increasing or decreasing the charging and discharging time of the equating-condenser C.

G is a receiving-instrument, which is worked by torsion.

n is a metal bar, preferably round, securely clamped to two upright pillars, and provided with two projecting arms—one for operating the local-circuit devices, the other to secure an armature placed over an electro-magnet, which, acting on this armature, twists the bar. The twist, length, or size of the bar varies its periodic vibrating time. Hence it is very quickly adjusted by twisting it to the right or left and tightening its clamping-screw.

X is a magnet, placed in the main-line or bridge wire, with its cores facing those of a larger inductive magnet, Z, the wire upon which is connected to the magnet Q.

18 is a reed, polarized by the permanently-magnetized horseshoe-magnet 19. The passage of waves through X of one polarity causes positive and negative inductive currents to be thrown into Z and Q and causes the vibration of the reed 18.

B is a double-reed instrument, each of which is provided with an electro-magnet, and the extreme ends provided with contact-points. These reeds are tuned nearly alike, one being a little more flat than the other, so that its amplitude of vibration is not so great as the other. One part of the local circuit is connected to one reed, while the other part is con-

nected to the other reed. This local circuit contains a battery and sounder.

When no waves periodic with the vibrating time of B are transmitted from the distant station, the points on the extreme ends of the reed are not in contact and the local circuit is open; but if a proper series of waves is sent, both reeds are set vibrating, and, as one has a slightly greater amplitude than the other, they come in contact, close the local circuit, and vibrate together as long as the proper waves come over the wire.

I claim as my invention—

1. The combination, in an acoustic telegraph, of opposing batteries, a vibrating reed, and a short circuit to one of the batteries, opened and closed by the action of such reed, substantially as set forth.

2. In an acoustic-telegraph instrument, a torsion-rod, *n*, and an electro-magnet for vibrating the same, substantially as set forth.

3. The combination, in an acoustic-telegraph instrument, of two reeds, one having a slightly different vibration from the other, and a local circuit to a sounder passing through such reeds, substantially as and for the purposes set forth.

Signed by me this 3d day of April, A. D. 1876.

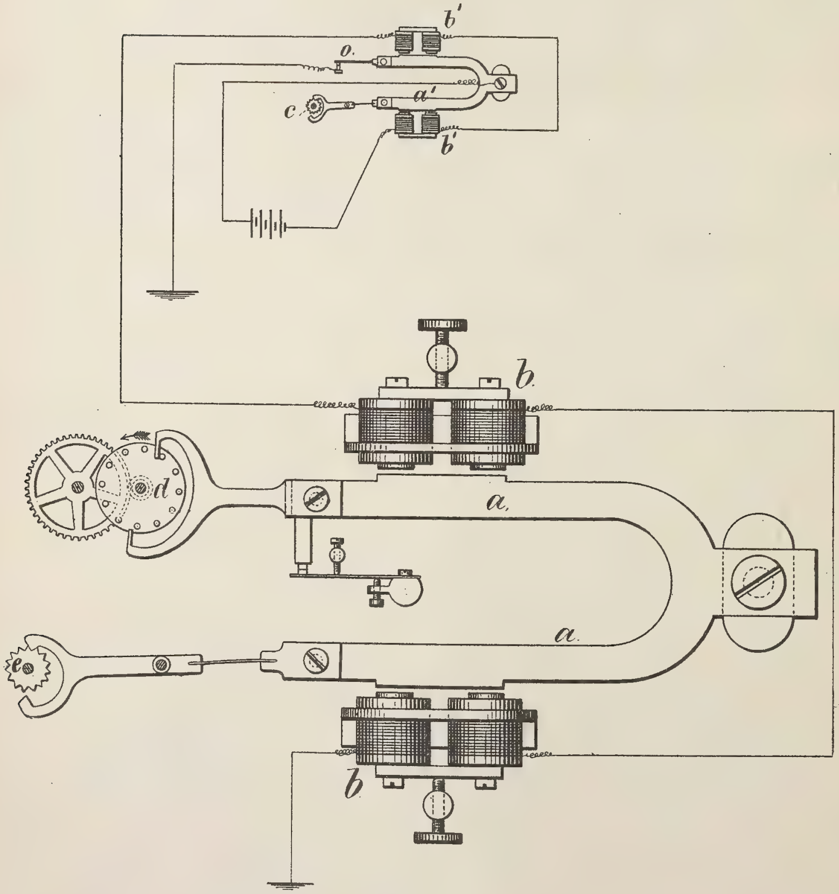
THOS. A. EDISON.

Witnesses:
HAROLD SERRELL,
CHAS. H. SMITH.

T. A. EDISON.

Synchronous Movements for Electric Telegraphs.

No. 200,032. Patented Feb. 5, 1878.



Witnesses

Chas H. Smith

Geo. T. Pinckney

Inventor.

Thomas A. Edison.

per Lemuel W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN SYNCHRONOUS MOVEMENTS FOR ELECTRIC TELEGRAPHS.

Specification forming part of Letters Patent No. **200,032,** dated February 5, 1878; application filed November 1, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Synchronous Movements, of which the following is a specification:

The object of this invention is to produce the rotation of two or more shafts in perfect unison, whether they are near each other or more or less remote. This is available for controlling the movement of type-wheels in printing-telegraphs at distant stations, or for regulating the rotation of other mechanisms.

I make use of a reed or tuning-fork carefully tuned, and kept in vibration by the action of one or more electro-magnets; and in cases where the reeds or tuning-forks are in different places in the electric circuit the movement of one of such tuning-forks governs the electric pulsations passing to the others. This insures uniformity of vibration.

The electric circuits may be arranged in any desired known manner. Circuits of this character have been used by me.

In the drawing, a a' represent tuning-forks; b b', the magnets for operating upon them to maintain the vibration, and o a circuit-opener to make and break the electric circuit in which the electro-magnets are placed. c d e are the shafts that are to be regulated in unison. There may be two or more of them.

Upon each shaft is a ratchet or escapement wheel, and upon the tuning-fork or reed is an arm carrying pallets or an escapement.

If a train of gearing and a weight or spring is used to revolve either of the shafts, the pallets will be shaped as an escapement to allow the wheel and shaft to rotate only at the speed resulting from the vibrations of the escapement by the reed or tuning-fork.

If the pallets are made wedge-acting, so as to move the wheel and shaft around by the vibration of the pallets, then the shaft may receive its revolving power from the reed itself.

Under any circumstances the speed of revolution will be the same in all the shafts if the number of teeth on the wheels is the same, or proportionate if the number of teeth is different, the vibrations of the pallets being in all instances the same.

I claim as my invention—

1. The combination, with a reed or tuning-fork, and an electro-magnet and circuit-breaker to maintain the vibration thereof, of pallets, a toothed wheel, and a shaft receiving its revolving motion from, or being controlled by, the vibrations of the reed or tuning-fork, substantially as set forth.

2. The combination of two or more reeds or tuning-forks, corresponding electro-magnets, and a circuit-breaker with two or more revolving shafts, toothed wheels, and pallets moved by the vibration of the reeds, substantially as and for the purposes set forth.

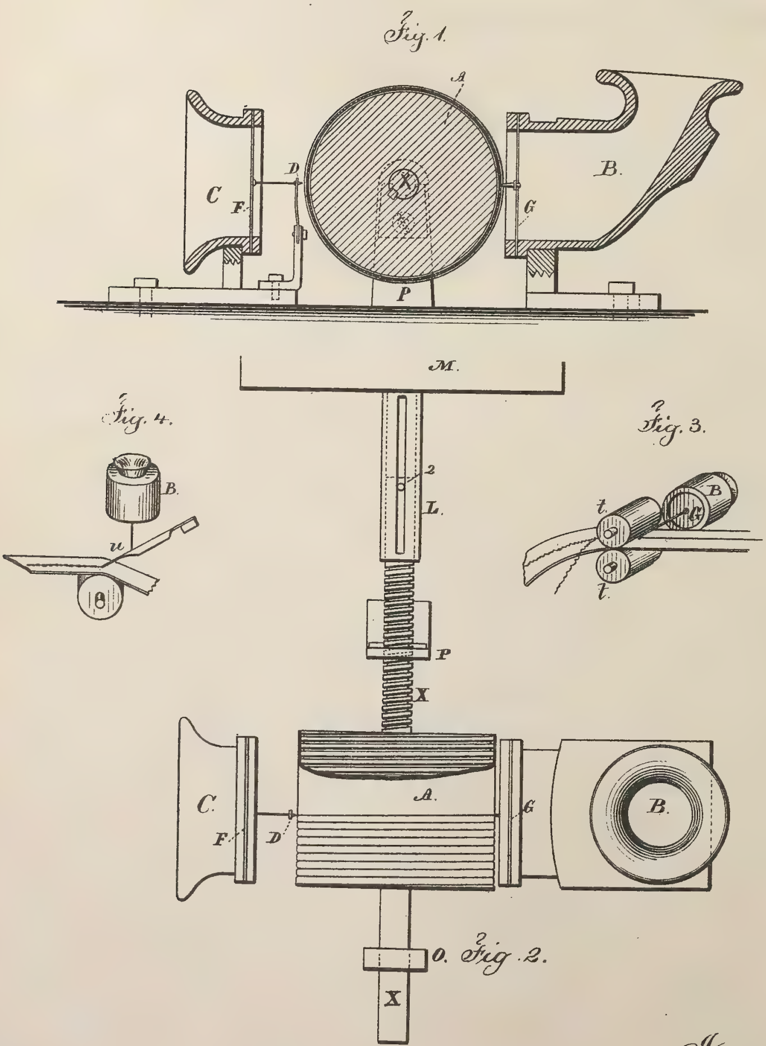
Signed by me this 30th day of October, A. D. 1876.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.
Phonograph or Speaking Machine.

No. 200,521. Patented Feb. 19, 1878.



Witnesses

Chas. H. Smith
Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN PHONOGRAPH OR SPEAKING MACHINES.

Specification forming part of Letters Patent No. **200,521**, dated February 19, 1878; application filed December 24, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Phonograph or Speaking Machines, of which the following is a specification:

The object of this invention is to record in permanent characters the human voice and other sounds, from which characters such sounds may be reproduced and rendered audible again at a future time.

The invention consists in arranging a plate, diaphragm, or other flexible body capable of being vibrated by the human voice or other sounds, in conjunction with a material capable of registering the movements of such vibrating body by embossing or indenting or altering such material, in such a manner that such register-marks will be sufficient to cause a second vibrating plate or body to be set in motion by them, and thus reproduce the motions of the first vibrating body.

The invention further consists in the various combinations of mechanism to carry out my invention.

I have discovered, after a long series of experiments, that a diaphragm or other body capable of being set in motion by the human voice does not give, except in rare instances, superimposed vibrations, as has heretofore been supposed, but that each vibration is separate and distinct, and therefore it becomes possible to record and reproduce the sounds of the human voice.

In the drawings, Figure 1 is a vertical section, illustrating my invention, and Fig. 2 is a plan of the same.

A is a cylinder having a helical indenting-groove cut from end to end—say, ten grooves to the inch. Upon this is placed the material to be indented, preferably metallic foil. This drum or cylinder is secured to a shaft, X, having at one end a thread cut with ten threads to the inch, the bearing P also having a thread cut in it.

L is a tube, provided with a longitudinal slot, and it is rotated by the clock-work at M, or other source of power.

The shaft X passes into the tube L, and it is rotated by a pin, 2, secured to the shaft, and passing through the slot on the tube L, the object of the long slot being to allow the shaft X to pass endwise through the center or support P by the action of the screw on X. At the same time that the cylinder is rotated it passes toward the support O.

B is the speaking-tube or mouth-piece, which may be of any desired character, so long as proper slots or holes are provided to re-enforce the hissing consonants. Devices to effect this object are shown in my application, No. 143, filed August 28, 1877. Hence they are not shown or further described herein.

Upon the end of the tube or mouth-piece is a diaphragm, having an indenting-point of hard material secured to its center, and so arranged in relation to the cylinder A that the point will be exactly opposite the groove in the cylinder at any position the cylinder may occupy in its forward rotary movement.

The speaking-tube is arranged upon a standard, which, in practice, I provide with devices for causing the tube to approach and recede from the cylinder.

The operation of recording is as follows: The cylinder is, by the action of the screw in X, placed adjacent to the pillar P, which brings the indenting-point of the diaphragm G opposite the first groove on the cylinder, over which is placed a sheet of thick metallic foil, paper, or other yielding material. The tube B is then adjusted toward the cylinder until the indenting-point touches the material and indents it slightly. The clock-work is then set running, and words spoken in the tube B will cause the diaphragm to take up every vibration, and these movements will be recorded with surprising accuracy by indentations in the foil.

After the foil on the cylinder has received the required indentations, or passed to its full limit toward O, it is made to return to P by proper means, and the indented material is brought to a position for reproducing and rendering audible the sounds that had been made by the person speaking into the tube B.

C is a tube similar to B, except that the diaphragm is somewhat lighter and more sensitive, although this is not actually necessary. In front of this diaphragm is a light spring, D, having a small point shorter and finer than

the indenting-point on the diaphragm of B. This spring and point are so arranged as to fall exactly into the path of all the indentations. This spring is connected to the diaphragm F of C by a thread or other substance capable of conveying the movements of D. Now, when the cylinder is allowed to rotate, the spring D is set in motion by each indentation corresponding to its depth and length. This motion is conveyed to the diaphragm either by vibrations through a thread or directly by connecting the spring to the diaphragm F, and these motions being due to the indentations, which are an exact record of every movement of the first diaphragm, the voice of the speaker is reproduced exactly and clearly, and with sufficient volume to be heard at some distance.

The indented material may be detached from the machine and preserved for any length of time, and by replacing the foil in a proper manner the original speaker's voice can be reproduced, and the same may be repeated frequently, as the foil is not changed in shape if the apparatus is properly adjusted.

The record, if it be upon tin-foil, may be stereotyped by means of the plaster-of-paris process, and from the stereotype multiple copies may be made expeditiously and cheaply by casting or by pressing tin-foil or other material upon it. This is valuable when musical compositions are required for numerous machines.

It is obvious that many forms of mechanism may be used to give motion to the material to be indented. For instance, a revolving plate may have a volute spiral cut both on its upper and lower surfaces, on the top of which the foil or indenting material is laid and secured in a proper manner. A two-part arm is used with this disk, the portion beneath the disk having a point in the lower groove, and the portion above the disk carrying the speaking and receiving diaphragmic devices, which arm is caused, by the volute spiral groove upon the lower surface, to swing gradually from near the center to the outer circumference of the plate as it is revolved, or vice versa.

An apparatus of this general character adapted to a magnet that indents the paper is shown in my application for a patent, No. 128, filed March 26, 1877; hence no claim is made herein to such apparatus, and further description of the same is unnecessary.

A wide continuous roll of material may be used, the diaphragmic devices being reciprocated by proper mechanical devices backward and forward over the roll as it passes forward; or a narrow strip like that in a Morse register may be moved in contact with the indenting-point, and from this the sounds may be reproduced. The material employed for this purpose may be soft paper saturated or coated with paraffine or similar material, with a sheet of metal foil on the surface thereof to receive the impression from the indenting-point.

I do not wish to confine myself to reproducing sound by indentations only, as the transmitting or recording device may be in a sinuous form, resulting from the use of a thread passing with paper beneath the pressure-rollers *t*, (see Fig. 3,) such thread being moved laterally by a fork or eye adjacent to the roller *t*, and receiving its motion from the diaphragm G, with which such fork or eye is connected, and thus record the movement of the diaphragm by the impression of the thread in the paper to the right and left of a straight line, from which indentation the receiving-diaphragm may receive its motion and the sound be reproduced, substantially in the manner I have already shown; or the diaphragm may, by its motion, give more or less pressure to an inking-pen, *u*, Fig. 4, the point of which rests upon paper or other material moved along regularly beneath the point of the pen, thus causing more or less ink to be deposited upon the material, according to the greater or lesser movement of the diaphragm. These ink-marks serve to give motion to a second diaphragm when the paper containing such marks is drawn along beneath the end of a lever resting upon them and connected to such diaphragm, the lever and diaphragm being moved by the friction between the point being greatest, or the thickness of the ink being greater where there is a large quantity of ink than where there is a small quantity. Thus the original sound-vibrations are reproduced upon the second diaphragm.

I claim as my invention—

1. The method herein specified of reproducing the human voice or other sounds by causing the sound-vibrations to be recorded, substantially as specified, and obtaining motion from that record, substantially as set forth, for the reproduction of the sound-vibrations.

2. The combination, with a diaphragm exposed to sound-vibrations, of a moving surface of yielding material—such as metallic foil—upon which marks are made corresponding to the sound-vibrations, and of a character adapted to use in the reproduction of the sound, substantially as set forth.

3. The combination, with a surface having marks thereon corresponding to sound-vibrations, of a point receiving motion from such marks, and a diaphragm connected to said point, and responding to the motion of the point, substantially as set forth.

4. In an instrument for making a record of sound-vibrations, the combination, with the diaphragm and point, of a cylinder having a helical groove and means for revolving the cylinder and communicating an end movement corresponding to the inclination of the helical groove, substantially as set forth.

Signed by me this 15th day of December, A. D. 1877.

THOS A. EDISON.

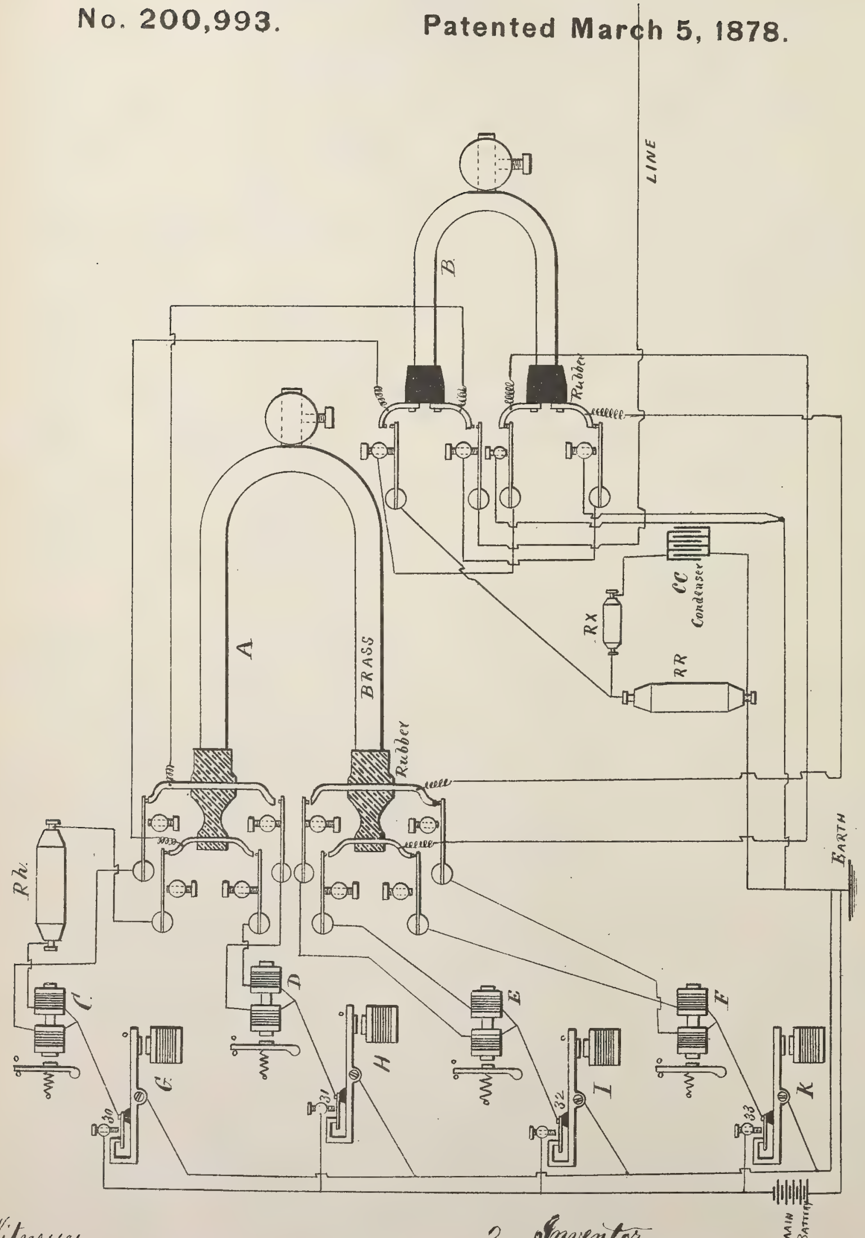
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets—Sheet 1.

T. A. EDISON.

Acoustic Telegraph.

No. 200,993. **Patented March 5, 1878.**



Witnesses.
Chas. H. Smith
Harold Serrell

Inventor.
Thomas A. Edison
per Lemuel W. Serrell atty.

2 Sheets—Sheet 2.

T. A. EDISON.
Acoustic Telegraph.

No. 200,993. Patented March 5, 1878.

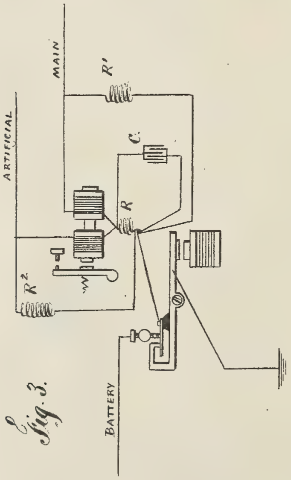


Fig. 3.

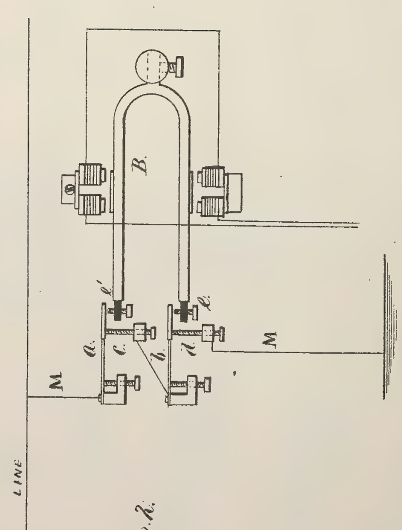


Fig. 2.

Witnesses.
Chas H Smith
Harold Serrell

Inventor
Thomas A. Edison
per Lemuel W. Serrell atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN ACOUSTIC TELEGRAPHS.

Specification forming part of Letters Patent No. **200,993,** dated March 5, 1878; application filed September 18, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

The object of this invention is to transmit eight different messages at the same time over a single circuit without interference with one another.

The invention relates, primarily, to the method fully described in my application No. 122, by which one single circuit is transferred from one set of instruments at both ends of the line to several other sets, one after the other, alternately, thus creating four distinct signaling-circuits.

The present invention more particularly relates to a method by which each signaling-circuit so created can be again doubled by a manipulation of the currents, thus allowing of the transmission of four messages in one direction at the same time that four messages are sent in the opposite direction.

The diagram illustrates the connections at one terminal station only, the connection at the distant station being precisely the same.

A is the large transfer tuning-fork, making thirty vibrations per second, and kept in constant vibration by the interception of the local circuit, in which its magnets (not shown) are placed by the main-line tuning-fork upon the controlling-line, as in aforesaid application No. 122. B is another fork, placed in the same local circuit, but making double the number of vibrations of A—*i. e.*, sixty per second.

The method by which these local tuning-forks at both terminals are kept in accurate unison is fully described in my aforesaid application, and the contact-points, instruments, and connections are arranged exactly as shown in that application, excepting that both A and B are provided with an extra set of springs, and the receiving-magnets with extra coils, and to which extra springs, connections, and coils is attached an artificial line of about the same resistance and of about the same electro-static capacity as that of the real line, so that when the line is being transferred from one set of instruments to the other the artificial line is at the same time transferred to the same instruments, which object is attained by causing the relay-magnets to have two sets of coils, one through which the main-line current passes in one direction, while through the other the current of the artificial line passes in the opposite direction. The latter, when its resistance is properly adjusted, allows of the transmission of current through the signaling-relays to the distant station without affecting such relays, which are free to receive the message from the distant station, and the same action takes place on all the instruments at both terminals.

C, D, E, and F are the double-coil relays, C being connected to the spring 30 of the transmitter G, D to 31 of H, E to 32 of I, and F to 33 of K, the levers of all of the transmitters being connected to earth.

Immediately over these springs are contact-points connected to the main battery. Either spring is brought in contact with its contact-point upon closing the key (not shown) of a local circuit, in which the electro-magnet of the transmitter is placed. At the same time that the point comes in contact with the spring it separates the spring from the earth-wire. This puts the battery in connection with the double spool of the relay. At the moment when the main line is connected at both ends by the vibration of the forks the current from the battery passes through one of the coils to the distant station, and would tend to close the relay; but at the same time the battery-current passes through the other coil (in an opposite direction) over the artificial line; and as the resistance of that is such that the current strength in each coil is the same, but the tendency opposite, and as the static charge and discharge are the same on both, the relay remains unaffected, and is ready to receive signals from the distant station. The high fork B serves to split the main line into two parts, and also the artificial line into two parts, allowing both the main line and the artificial line to remain in contact with the earth for a short period of time after it has been connected to one split, and disconnecting it from the earth just before it is placed in contact with the other split. R R is the resistance-coil, which serves to create the artificial line. c' c' is the condenser, which serves to give the artificial line the proper electro-static capacity, while $R^{\times}$ is an adjustable resistance, which serves to increase or decrease the discharging

time of the condenser to meet the various discharging times of different circuits.

R *h* is a resistance-box, which, in practice, I shall probably insert in each of the splits passing to the artificial line, for the purpose of obtaining a more perfect balance of the two circuits, as it has been found difficult to construct differential magnets so that all coils shall produce the same amount of magnetism in their cores.

In addition to the apparatus shown, I propose to insert a fork or forks making the same number of vibrations as B at various stations along the line, and keep them in motion by acoustic relays in the controlling-line, passing through the same stations, and arranging the contact-points as shown in Fig. 2, for the purpose of discharging the wire between each wave or vibration, which will enable me to work very long circuits. A shunt, *m*, passes to the spring *a*, and connects it to earth, (and at that particular period of time when neither prong is in contact with *a* or *b*.) The spring *a* rests upon *c*, and is connected to *b*, thence through *d* to earth; but when the fork is a little over the center of point of rest, either on one side or the other, the continuity of the earth-connection is interrupted either by the separation of *a* from *c*, or *b* from *d*.

This action of putting the line to earth outside of the instruments between each vibration takes place, or may take place, at both terminals, and at any number of way-stations.

On very long lines more perfect signaling is attained by connecting the receiving-instrument as in Fig. 3.

R is a large resistance, shunted with a condenser, c'. R^1 and R^2 are two smaller resistances in shunts to lessen the total resistance of the circuit, and to provide a circuit for the discharge of the condenser-current, which, by its action upon the relay, serves to neutralize, to some extent, the static discharge from the line due to the passage of the distant signaling-current.

I do not wish to confine myself to any particular relay, or the use of single currents, as polarized relays and reversed circuits may be used; neither do I wish to confine myself to the use of differential-coil relays for balancing the outgoing current, as the whole arrangement may be placed in a Wheatstone bridge, and which will be the subject of another application; neither do I wish to confine myself to the transmission of eight messages, as each of the four circuits (obtained by the rapid transfer of the line upon the several instruments) can be split up again by employing another set of higher and lower forks, and each of the eight circuits so obtained can be doubled in the same manner as those already described by a mere duplication of springs and points; or, instead of splitting the wire up into eight wires, it can remain as in this application, and each of the four splits may contain two signaling-instruments, one responding to positive and negative currents independent of their tension, and the other to strong and weak currents independent of their polarity, the connection being made to each split in the same manner as they would if such split were an actual wire.

Upon reference to my aforesaid application No. 122, it will be understood that the forks B vibrate exactly in time with each other at the two ends of the line, that the forks A also vibrate in time with each other at the two ends of the line, but at half the speed of the forks B.

In the vibrations of a musical fork, the prongs both move away from each other, and then both move toward each other, and this feature and the synchronous movements cause the circuit-closers to be operated exactly in harmony, so that when the key G is operated the circuit from the battery, which is thereby closed, will only reach the corresponding receiving-instrument at the distant station, and so on of all the other signaling-instruments, the circuits being simultaneously opened and closed to each instrument at both ends of the line at each vibration of the fork, and also closed to the artificial line, and all the circuit-closers are similar to circuit-preserving keys, so that the circuit is not entirely broken at any time.

I claim as my invention—

1. In a transmitting telegraph-instrument, two tuning-forks, extra contact-points, and circuit-connections to the main and artificial lines, substantially as and for the purposes set forth.

2. The combination, with the several tuning-forks or equivalents composing the transferring mechanism, of a main line and an artificial line with devices connected to the latter to create proper conditions, and receiving-instruments, for the purpose set forth.

3. The combination of several continuity-preserving transmitting-instruments, differential-coil relays, resistance-coils, and condensers, substantially as shown, with the vibrating tuning-forks, or equivalent devices, at both terminals, with the main line and artificial line, for the purposes set forth.

4. The tuning-fork B, Fig. 2, spring *a b*, points *c d*, and line and earth wire *m*, all arranged and operated substantially as set forth, and for the purposes specified.

5. The shunts R^1 and R^2, Fig. 3, resistance R, condenser c', in combination with the electro-magnet or other receiving-instrument, for the purposes set forth.

Signed by me this 26th day of August, A. D. 1876.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
GEO. D. WALKER.

T. A. EDISON.

Automatic Telegraph Perforator and Transmitter.

No. 200,994. Patented March 5, 1878.

Fig. 1.

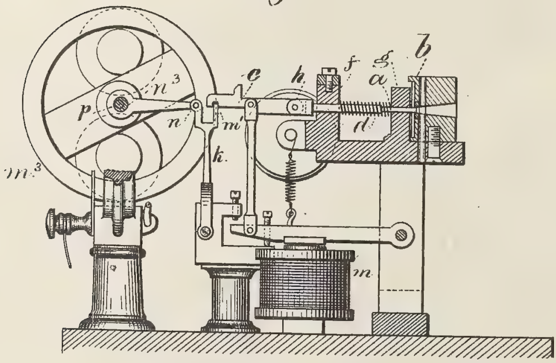
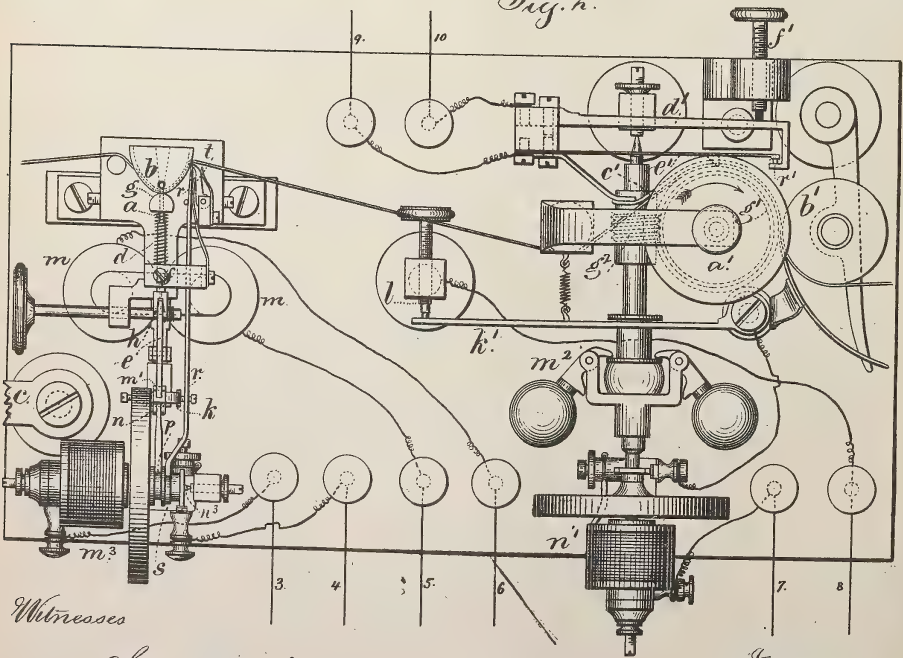


Fig. 2.



Witnesses

Chas. H. Smith

Harold Serrell

Inventor

Thomas A. Edison

per Lemuel W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN AUTOMATIC-TELEGRAPH PERFORATOR AND TRANSMITTER.

Specification forming part of Letters Patent No. **200,994,** dated March 5, 1878; application filed November 11, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Telegraphs, of which the following is a specification:

The object of this invention is to transmit Morse characters over a local circuit or telegraph-line by any of the usual methods, and record the same simultaneously and automatically by perforating a strip of paper, which strip, so perforated, serves to retransmit the same message over other circuits or lines.

By this improvement a record of the message can be made at the transmitting or receiving station, or at any intermediate station, by the perforated paper, without obstructing the operation of the line, and that strip can be used for subsequent automatic transmission.

I make use of a shaft revolved, preferably, by an electric engine, and operating a paper-feed and a punch, the feed taking place when the punch is out of the paper, and there is a coupler between the power and the punch for connecting or disconnecting the latter, which coupler is operated by an electro-magnet, so that the message, passing through the magnet, will be effective in operating the perforator, and the perforated strip serves as a record, or it can be used for retransmission.

The invention further consists in the mechanism for retransmitting the message from the perforated strip.

In the drawing, Figure 1 is a sectional elevation of the punching mechanism, and Fig. 2 is a plan of the complete apparatus.

a is the punch. *b* is the die between which the paper passes from the roll upon the arm *c*. *d* is the spiral spring which aids in withdrawing the punch from the paper. The bearings of the punch are *f* and *g*. *e* is a coupler, secured to the punch at *h*, and provided with a notch at its extreme end. The coupler is moved up and down by the lever of the magnet *m*.

k is a pivoted lever, provided with two prongs at its end, one of which, m^1, catches in the notch on *e* when the lever of the magnet is attracted, thus connecting the coupler *e* to m^1. The other prong of *k* is connected by the link and joint *n* to the eccentric *p* upon the engine-shaft n^3. *r* is the paper-feeding lever, also connected to the engine-shaft by an eccentric, *s*.

The eccentric *p* is set at one hundred and eighty degrees, or nearly so, to the eccentric *s*, so that the punch enters the paper while the feed-lever is drawing back, and the punch comes out of the paper just as the feed-lever commences to move the paper forward, thus producing an accurate timing of the punching and feeding devices.

The electric engine m^3, for actuating the punch and paper-feed, is in the circuit 3 4 of a local battery.

The feed-lever *r* is provided with points, which engage with the paper and allow it to be carried forward. *t* is a click, which prevents the paper from receding when *r* is drawn back.

The operation is as follows: When the circuit in which the magnet *m* is placed is open, the coupler *e* is thrown upward, and the punch remains out of the paper, and receives no movement; but the paper-feed *r* continues to move the paper forward at a regular rate. If, now, the circuit in which *m* is placed is closed, the magnet becomes energized, its lever is attracted, and the coupler *e* is brought down upon the prong m^1, locked to it, and immediately the punch reciprocates rapidly, passes through and out of the paper. The first movement punches a hole the same size as the punch, but thereafter, and so long as the magnet *m* is closed, punches only crescent-shaped pieces at each movement, as the paper-feed is only a fraction of the distance covered by the punch; hence an elongated slot or perforation is made, its length depending upon the length of time that *m* is energized. Immediately that the circuit containing *m* is broken, the coupler *e* is thrown out of contact with m^1, the punch ceases to be reciprocated, while the lever *r* continues to feed the paper, thus forming the spaces.

As the engine-shaft n^3 makes several thousand revolutions per minute, the perforated characters can be formed with great rapidity.

The electro-magnet *m* is in a circut, 5 6, to a distant station, in which circuit there is a

receiving-instrument, battery, and finger-key, and the message transmitted to said distant instrument corresponds to the message perforated in the strip of paper by the punch a. After the strip has been punched it is passed through the transmitting or translating machine, which consists of a drum, a', provided with a slot around its whole circumference, and in its center.

b' is the roller for pressing the paper against the drum, so that it may be carried forward. c' is a forked spring, used for holding the paper against the drum, and also to gripe the end of the paper as its end is passed between the spring and the drum. g^1 is a pinion-wheel, engaging with a worm, g^2, upon the shaft of the electric engine n^1, and said engine is in a circuit, 7 8, of a local battery. m^2 is a governor, which, as the speed increases, causes the lever k' to be withdrawn from l, thus breaking the circuit in which the engine is placed.

By the use of the worm and pinion a very even rotation of the drum a' is attained, while allowing great rapidity of rotation of the electric engine, which is desirable, and by the use of the electric governor any required speed is easily attained. The circuit-breaking devices consist of a duplex spring, e' d', and the wires 9 10, connecting with e' d', form part of the circuit to a distant station, to which the message is to be retransmitted. e' is provided with a V-point somewhat smaller than the slot in the periphery of the drum a. This point is in line with the perforated characters, and when resting on the paper the extreme end of e', which is tipped with platina, is separated from the point r' of d'; but when a perforation passes under the point on e', the said point enters into the slot in the drum, bringing the end of e' in contact with r, closing the circuit, which is again broken the moment the paper intervenes between the point of e' and the drum. f' is a screw for adjusting the contact-points to or from the drum a.

I will mention that the electric engines might be displaced, both in the puncher and in the transmitter, by clock-work, or by tuning forks or reeds set in motion by electro-magnets—in the case of the puncher one prong serving to actuate the punch, while the other prong would actuate the paper-feed, and in the case of the transmitter the tuning-fork could, by a suitable toothed wheel and click, give practically a continuous rotation to the drum, the speed being regulated by movable weights on the prongs of the fork, or by double pressure-springs.

I will also mention that if the puncher is to be used merely for preparing the paper for transmission, the locking-coupler e' might be actuated by a movement derived from a Morse key, without the use of electricity; and where great speed is required in perforating, the shaft upon which the eccentrics are placed might be rotated by hand, a small pulley being secured to the shaft, which would be connected to a very large one by a belt or geared by toothed wheels, and the whole set in motion by hand or foot power.

I will also mention that an absolute lock like the lever e and prong m^1 is not absolutely requisite when considerable power is used to revolve the eccentrics, for if plenty of power is used, as with hand-power, the spiral spring d around the punch can be strengthened and made to draw the punch out without aid from the eccentric-lever, and the mere insertion of a wedge between the end of m^1 and a continuation of the punch a will serve to actuate the punch. Such wedge is free to be withdrawn at each revolution of the shaft carrying the eccentric, and there is but little movement; hence a very weak power will suffice to throw the wedge in and out.

I will also mention that the punch and paper-feeding mechanism may be reciprocated continuously, and the characters formed by using a movable die and paper-feeding wheel, both of which can be brought toward the punch and feed-click by an electro-magnet, or by hand. It is not even essential that the paper-feed click should impinge directly upon the paper, as the paper may be passed over a drum and the drum rotated by the feed-click engaging in the teeth of a ratchet-wheel upon the shaft of the same.

I will also mention that when it is required that reverse currents should be used, so as to enable the punching mechanism to be controlled by a polarized relay whose lever operates the magnet m, two punches may be used, one under the other, but separated, say, one-thirty-second of an inch, and the locking mechanism so arranged that when m is closed the top punch will enter the paper, and when open the eccentric will be locked to the other punch when it enters the paper, thus causing the spaces between the characters in the upper row to have perforations immediately below them in the second row. In this case the transmitting-drum is to be provided with two grooves and two contact-springs, one connected to the positive pole of a battery, while the other is connected to the negative pole of another battery, thus allowing the transmission of alternate currents. Even one battery could be used and the springs arranged to reverse the same.

I claim as my invention—

1. The punch and die a b and notched coupler e, in combination with the eccentric p, fork k, and electro-magnet m, substantially as set forth.

2. In a perforating apparatus, a continuously-revolving shaft and a step-by-step feed, operated thereby, in combination with a punch that is actuated by the shaft while the paper is quiescent, a coupler to connect the power and the punch, and an electro-magnet to move such coupler, substantially as set forth.

3. Punch and paper-feeding mechanism re-

ciprocated by the eccentrics *p* and *s*, when the same are arranged in such a position that the paper is only fed when the punch is clear of the die.

4. The transmitter consisting of a drum, a', contact-points and springs e' d' r', electric engine n^1, and governor m^2 k' l, all arranged and operated substantially as specified, and for the purposes set forth.

Signed by me this 30th day of October, A. D. 1876.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.
Speaking Machine.

No. 201,760. Patented March 26, 1878.

Fig. 1.

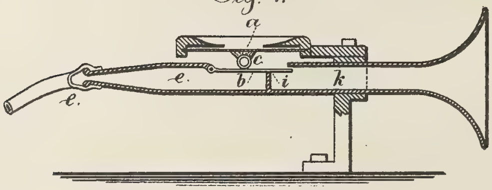


Fig. 2.

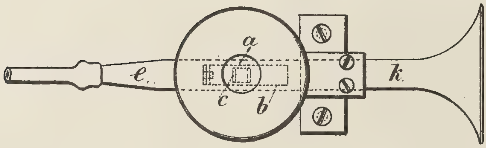
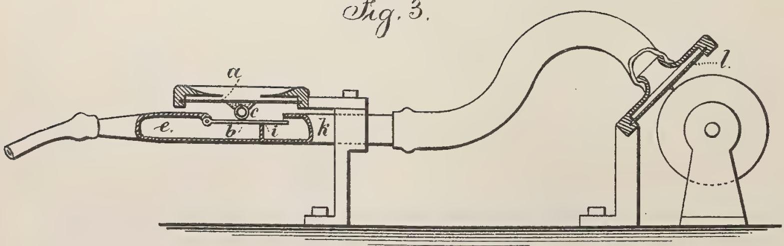


Fig. 3.



Case 153.

Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thos. A. Edison.
per Lemuel W. Serrell
atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN SPEAKING-MACHINES.

Specification forming part of Letters Patent No. **201,760**, dated March 26, 1878; application filed March 4, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Machines, (Case 153,) which I term the "Aerophone," and of which the following is a specification:

The object of this invention is to reproduce the human voice or other sounds with greatly-increased volume or force.

Articulation produces certain atmospheric sound waves or vibrations in a given relation to each other in respect to volume or character. The sound-waves of words uttered in a whisper correspond generally to those uttered in the loudest tones, except in the volume.

In my phonograph, heretofore secured by me, (Case No. 149,) the sound produced by the instrument corresponds to the sound acting upon the diaphragm, only less in volume.

The object of the present invention is to reverse the action of the phonograph, and cause the human voice or other source of sound to reproduce that sound in tones that are louder than the original utterances, thereby enabling a feeble voice to be heard distinctly to any desired extent within the capacity of the instrument.

I make use of a diaphragm, against which the sound-vibrations are directed from the voice or other primary source of sound, and this diaphragm or other body moved by such sound-vibrations is made to control the exit of air, steam, or other fluid under pressure, and so set in motion secondary sound-vibrations, the same as the primary sound-vibrations, except of greater volume. The relative volumes of the sound-vibrations will depend upon the pressure of the fluid and the opening for the escape of the same.

My invention is available for giving orders upon vessels, for signaling distant vessels, for military orders, for orders at fires, for communicating between engineers of passing locomotives, for station-signals, and for addressing large assemblies, or for giving audible utterances that are sufficiently powerful to be heard above surrounding noise or confusion.

In the drawings, Figure 1 is a section. Fig. 2 is a plan of the instrument as adapted to an organ-pipe or trumpet for direct action in increasing the volume of the sound; and Fig. 3 is a section of the instrument in connection with a phonograph, for increasing the amplitude of the vibration that makes the record.

The diaphragm *a* is acted upon by the human voice or other sound, and vibrated by the same. By the term "diaphragm" I mean any body capable of and adapted to respond to atmospheric sound-vibrations, so that the said vibrations shall be given to the diaphragm or its equivalent.

I make use of the vibrations of the diaphragm to operate a valve, *b*, that is connected with the diaphragm *a*, preferably by a section, *c*, of india-rubber tubing. The diaphragm is to be inclosed in a proper case, that directs the sound upon the diaphragm, and the valve is, by preference, balanced by being pivoted in the center, so that the pressure of the air, steam, or gas upon the valve does not interfere with its movement.

The air, gas, steam, or other fluid under pressure, is supplied from a suitable holder by the pipe *e*, and at *i* the valve allows or checks the escape of the said fluid into the pipe *k*. If the valve is covered with a sheet of india-rubber, secured at its edges and to the tubes *e* and *k*, leakage will be prevented, but the valve will be free to be moved by the diaphragm.

It will now be apparent that the valve will open more or less at *i*, according to the amplitude of vibration of the diaphragm, and hence that the air passing at this point will be a multiple of the sound-vibrations of the atmosphere acting upon the diaphragm; hence corresponding tones will issue from the tube or trumpet *k*, and by increasing the pressure of the fluid, so the volume of sound will be increased. My experiments and tests lead me to believe the apparatus capable of very great increase of the secondary sound over and above the primary controlling sound; and I remark that the apparatus employed may also be greatly varied, according to the object to be attained. Care is required to prevent interference with the clearness of the articulated sounds, in consequence of any musical resonance in any of the parts of the apparatus.

In Fig. 3 the parts before described are represented as combined with a receiving-diaphragm, *l*, that actuates a recording-point to

record the sound-vibrations, as in my aforesaid phonograph. In this case the indentations will be much greater, on account of the amplitude of the vibrations given to the disk.

It will be evident that the phonographic record may be employed instead of the diaphragm to operate the valve *b*, and thus allow the record to be made of the articulations, after which such articulations are reproduced in the same or in increased volume as the original utterances.

I claim as my invention—

1. The combination, with a diaphragm, or the record produced therefrom, of a valve and a supply of air, gas, steam, or other fluid under pressure, for reproducing sounds, substantially as set forth.

2. The method herein specified of producing sound, by causing primary sounds or articulations to act upon a diaphragm, and then controlling the exit of a fluid under pressure in harmony with the primary sounds, to produce secondary sounds corresponding with the primary sounds, but of different volume, substantially as set forth.

Signed by me this 28th day of February, A. D. 1878.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Speaking-Telegraph.

No. 203,013. Patented April 30, 1878.

Fig. 1.

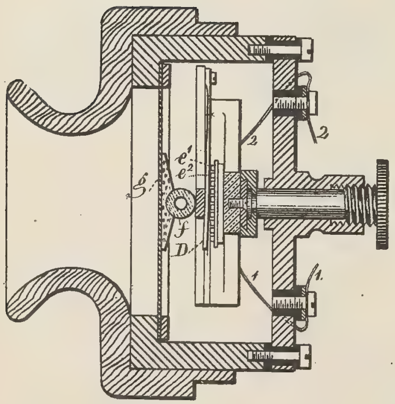


Fig. 2.

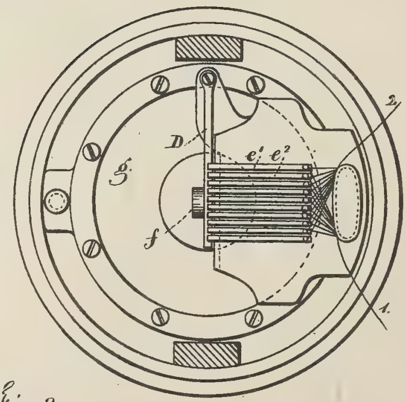


Fig. 3.

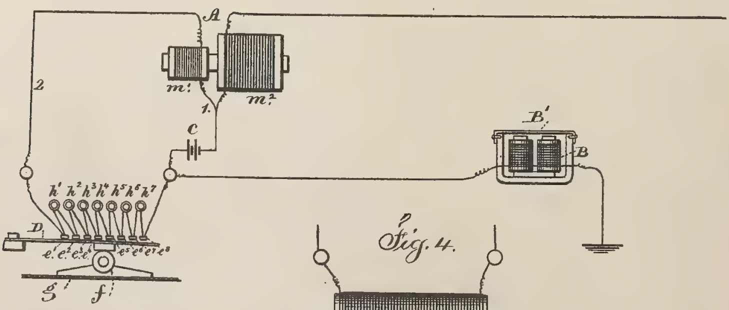


Fig. 4.

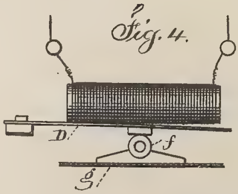


Fig. 5.

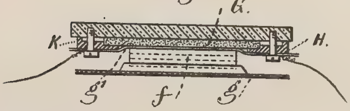
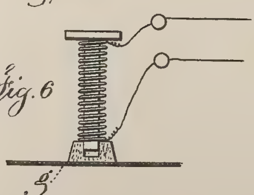


Fig. 6



Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison

per Lemuel W. Serrell atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEGRAPHS.

Specification forming part of Letters Patent No. **203,013**, dated April 30, 1878. Application filed December 13, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification.

The object of this invention is to transmit and receive oral communications over telegraphic circuits.

This telegraph is operated by sound-vibrations. I make use of a rheostat with numerous contact-points and a conductor that is operated by the sound-vibrations, and serves to short-circuit the rheostat to a greater or less extent according to the amplitude of vibration. I interpose an elastic cushion between the conductor and the diaphragm or other body moved by sound, to prevent false vibrations, and I employ an induction-coil and a local circuit, arranged in such a manner that with a weak local battery, the line-current is augmented and the rise and fall of electric tension is in proportion to the sound-vibrations.

Figure 1 is a section of the instrument for transmitting; and Fig. 2 is a view at the rear of the diaphragm, showing the manner of winding the rheostat-wires. Fig. 3 shows the diagram of connections for one terminal station.

A is an induction-coil, consisting of one bar of iron and two coils, m' and m^2, the latter being placed in the main line, in which the local battery c and the receiver B also forms a part.

m' is the primary inductive-magnet, of very low resistance, placed in a local circuit, 1 2, containing also the rheostat or resistance-coils h' h^2 h^3 h^4, &c.

e' e^2 e^3 e^4, &c., are springs, each one being connected to the juncture between each resistance-coil. These springs e' e^2, &c., are contiguous to the spring D, and when the spring D is moved it comes in contact with e' just a little before it does with e^2, and so on. When e' and e^2 are in contact with D the resistance h' is cut out of circuit, and if e^2 and e^3 are in contact with D the resistance h^2 is cut out, and so on, and contact between all the springs and D cuts all the resistance out of circuit.

For very powerful effects the resistance of m' should be less than one ohm, and the total resistance of h' h^2, &c., about five ohms. Then the slightest movement of the spring D, when properly adjusted, will cause a great rise and fall in the strength of the magnetism in the core of m', and a consequent powerful induced current will pass over the line and set the plate of the receiver at the distant station in vibration.

If the diaphragm g is set in powerful vibration a greater number of springs e e', &c., come in contact with D, and a greater disturbance of the magnetism of the core of m' takes place, transmitting a more powerful wave into the main line, which is in one direction when the diaphragm causes D to approach the springs, and in the contrary direction when it recedes therefrom, thus the strength of the waves sent into the main line are proportionate to the amplitude of vibration of the diaphragm.

I do not wish to confine myself to any particular arrangement of the springs e' e^2 e^3, &c., as they may be arranged to radiate from a center, like a sunflower, around a metallic disk beveled in the proper manner and secured to the diaphragm, so as to come in contact with one after the other of the springs as the diaphragm approaches. It is not even necessary that the springs should be worked in a local circuit, as the resistance between each spring may be greatly increased and the transmitter inserted directly in the main line with the receiver and battery.

Fig. 4 is a modification of the rheostat. The same consists of a cylinder of insulating material having a thread cut in it from end to end and containing wound very fine platina wire, the total resistance of which may be five ohms. The forward movement of the diaphragm g causes the spring D to short-circuit each convolution of the wire, one after the other, and thus decreases the resistance of the local circuit.

In Fig. 5 the wire-resistance is replaced by a semi-conductor, such as plumbago, at G, included in the local circuit, the connections being made by the metallic clamps K and H.

f is a piece of rubber tube fastened to the

diaphragm and faced with a thin piece of platina-foil, g', which acts in the same manner as the spring D in Figs. 2, 3, and 4. The forward movement of the diaphragm causes more and more platina to come in contact with the plumbago, thus allowing the greater part of the current to pass through the platina, according to the amplitude of the diaphragm-vibrations. Of course other materials, such as silicon, boron, sulphides of the heavy metals, and other conducting chemical compounds, may be used, or even very thin strips of gold, platina, silver, and other metals may be used in the same manner as the plumbago.

In Fig. 6 the change in the resistance of the coil of wire takes place longitudinally, a spiral of insulated wires being arranged on a stud of insulating material, and compressed or allowed to expand by the movement of the diaphragm, thus causing the various convolutions to short-circuit one another.

By this construction of apparatus and arrangement of circuits I am enabled to transmit upon the line electric undulations proportionate to the length of line, so as to produce the proper response at the distant receiving-magnet B and diaphragm-armature B′, because the rheostat will cause more or less resistance in the local circuit and the polarity of m^2 will alternate with the rise and fall of the electric tension in the local circuit, and the battery *c*, also being in the main line, will act to neutralize or augment the main-line current according to the polarity of that current and in proportion to the resistance of the local and main-line circuits, thus obtaining a powerful current on the line from a weak local current. The elastic cushion *f*, interposing between the diaphragm, or other article vibrated by the atmospheric sound-waves, and the short-circuiting conductors of the rheostat, prevents any musical vibrations of either D or *g*, and causes a gentle yielding movement and change of electric tension in proportion to the sound without risk of false vibrations.

I do not claim herein the disk of plumbago G shown in Fig. 5, as this is similar to that shown in my application No. 130; neither do I herein claim the sheet-iron diaphragm forming an armature to the electro-magnet, as that is shown in some of my former applications, and the resistance to the electric circuit is also varied by the motion of the diaphragm in said application No. 130. Therefore the same is not claimed herein.

I claim as my invention—

1. In a speaking-telegraph, the combination, with a diaphragm, of a rheostat or resistance-coils and a conductor vibrated by the diaphragm and acting to short-circuit more or less of the rheostat in proportion to the amplitude of the vibrations, substantially as set forth.

2. In combination with a diaphragm actuated by sound-vibrations and a metallic conductor, an elastic cushion, *f*, interposed between the diaphragm and said metallic conductor, to move the latter in proportion to the movement of the diaphragm, substantially as set forth.

3. In a speaking-telegraph, the combination, with the diaphragm and rheostat, of a local circuit and an induction-coil, substantially as set forth.

4. In a speaking-telegraph, an induction-coil, a rheostat, and a battery in a local circuit, and a main-line circuit passing through a second induction-coil and also through the battery, substantially as set forth.

Signed by me this 8th day of December, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

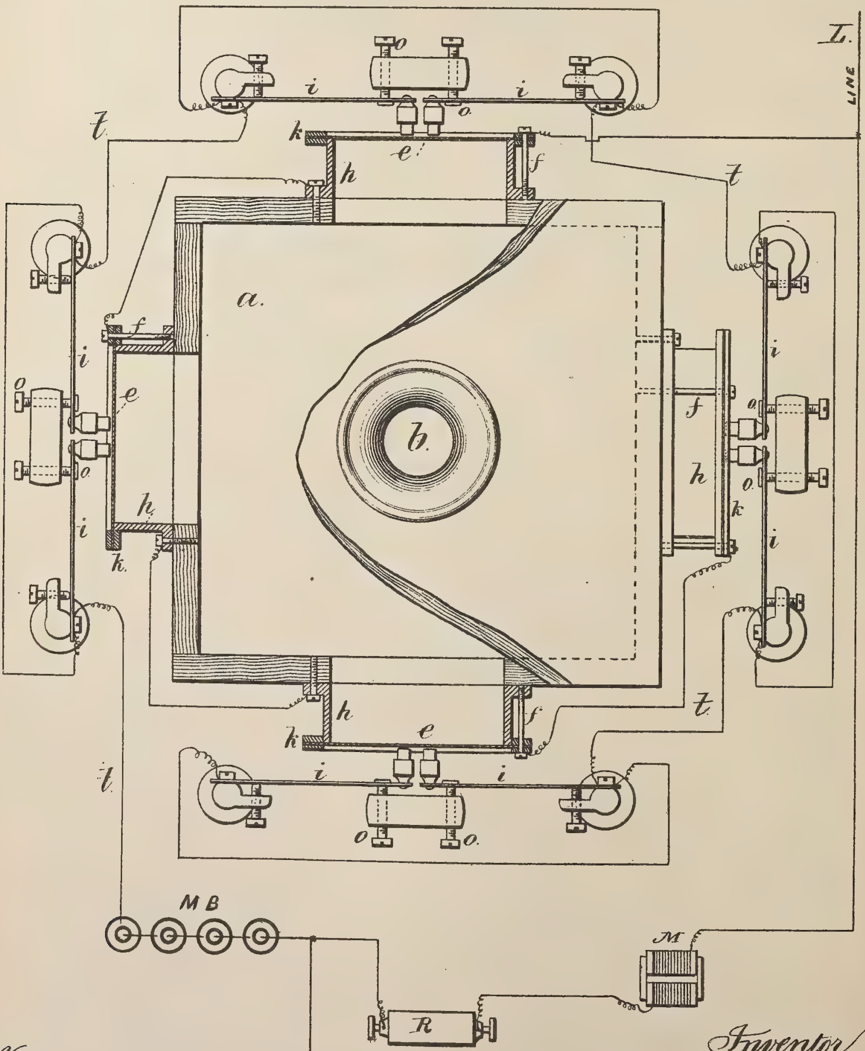
2 Sheets—Sheet 1.

T. A. EDISON.

Speaking-Telegraph.

No. 203,014. Patented April 30, 1878.

Fig. 1.



Witnesses

Chas H. Smith
Harold Serrell

Inventor

Thos A. Edison

per Lemuel W. Serrell

att'y

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

T. A. EDISON.

Speaking-Telegraph.

No. 203,014. Patented April 30, 1878.

Fig. 2.

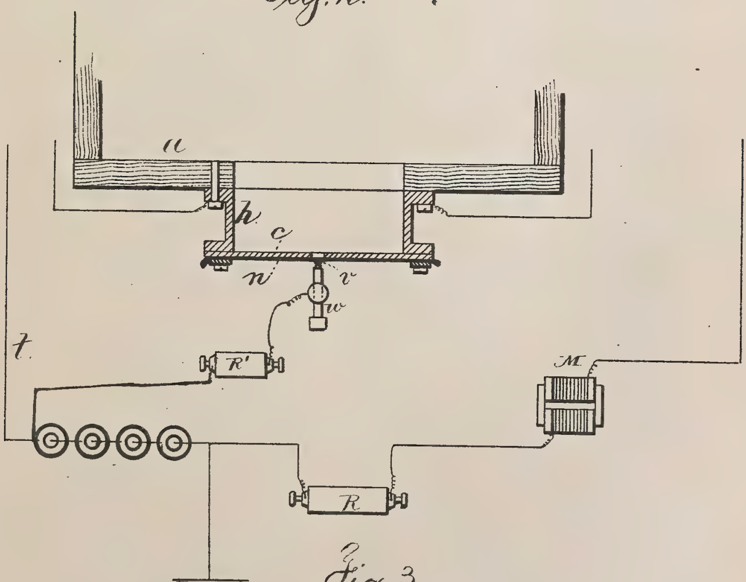
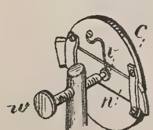


Fig. 3.



Witnesses

Chas H. Smith

Harold Serrell

Inventor.

Thos A. Edison.

per Lemuel W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEGRAPHS.

Specification forming part of Letters Patent No. **203,014**, dated April 30, 1878; application filed July 20, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification:

I make use of a resonant case with several tympans, adjusted to different degrees of tension or delicacy, and these are all so connected with contact-points in the metallic line-circuit that the electric pulsations will be sent over the line from one or more of these tympans, and operate upon an electro-magnet and receiving-tympan of a resonator.

By this arrangement it is sought to produce such undulations of the electric currents passing over the line that they will represent the inflections of the human voice speaking into the transmitting-resonator, and therefore the receiving-instrument will be correspondingly influenced.

In the drawing, Figure 1 is a plan view, partially in section; and Fig. 2 is an end view of one tympan and circuit-closing device.

The box *a* is of a suitable size and shape. At one side thereof there is a mouth-piece, *b*, adapted to receiving the sounds of the human voice as spoken into the resonant box *a*. This mouth-piece may be upon the top of the box, or at one of the sides thereof.

It is preferable that the hollow resonant box be cubical, in order that at its sides may be placed the tympans aforesaid. I have shown four such tympans. Each tympan is made similar to the head of a kettle-drum, but preferably of a plate of metal, and it covers an opening in one of the sides of the resonant box.

The edge of the tympan *e* is between the rings *k*, and rests against the end of the cylinder *h*; and there are screws *f*, by which to adjust the rings and apply greater or less strain to the tympan.

The tympans are all connected with the metallic line-circuit L, and in front of each there are one or more circuit-closing springs, *i*, preferably with carbon or plumbago points, and each spring is adjusted by the screw *o*, so that the point is in nearer or more remote proximity to the tympan. The springs *i* are all in the circuit *t* to the battery M B, and there is a ground-connection at G, and a shunt from the main line L to G, in which is placed a rheostat, R, and magnet-helix M, to neutralize the static charge and discharge.

It will now be evident that whenever the tympans, or any one of them, are vibrated by the action of the voice, the line-circuit will be connected to the battery, and pulsations sent that represent the vibrations of the tympan. I therefore construct or adjust the tympans so that they respond to different tones or modulations of the voice, in order that when a person speaks into the resonant box the sound will be responded to by one or more of the tympans, and pulsations will be sent upon the line coefficiently, so that the various modulations and tones of the voice will be represented by the electric pulsations, which, acting upon an electro-magnet at the receiving-station, will influence the resonant receiver and produce the same tones, whereby the articulation will be apparent to a listener.

On very long lines, owing to the excessive weakness of sound in uttering the hissing consonants, the electric pulsations resulting therefrom at a certain distance cease to be perceptible.

To overcome this, I arrange the device shown in Figs. 2 and 3 in place of one of the tympans, so as to increase the strength of the consonant waves, as in *ch*, S, T, P. This is accomplished by using a plate, *c*, with a small hole or slot near the center, in front of which is stretched a strip or piece of sheet-rubber, *n*, that is secured near each edge of the disk *c*, and laps a little over the hole in *c*; and upon the rubber is secured a small piece of platina-foil, *v*, an arm of which runs over to and makes connection with the plate *e*. Immediately opposite is a platina contact-screw, *w*, which is connected to the battery through a resistance, R′; and by regulating this, the hissing parts of speech may be increased or decreased instead of being lost, as in the other tympans, owing to the minute amplitude given them by these sounds, and also to the enormous resistance of the plumbago points to the slight pressure which these vibrations give. By using a platina point these vibrations are rendered very loud, and

by the employment of the rubber in front of the aperture in *c* great amplitude is obtained, even to the faintest hiss.

I do not herein make any claim to the transmission of electric currents varying in intensity proportionately to the sound-vibrations, as that is set forth in applications heretofore filed by me; and in my application No. 141, plumbago is described as acted upon by the vibrations of the diaphragm. I do not, therefore, claim the same herein.

I claim as my invention—

1. The combination, in the telegraphic circuit, of two or more tympans, a resonant box, and one or more circuit-closers to each tympan, substantially as set forth.

2. The plate *c*, provided with an aperture, an elastic membrane, and circuit-breaking connections, arranged and operated substantially for and in the manner set forth.

Signed by me this 16th day of July, A. D. 1877.

THOS. A. EDISON.

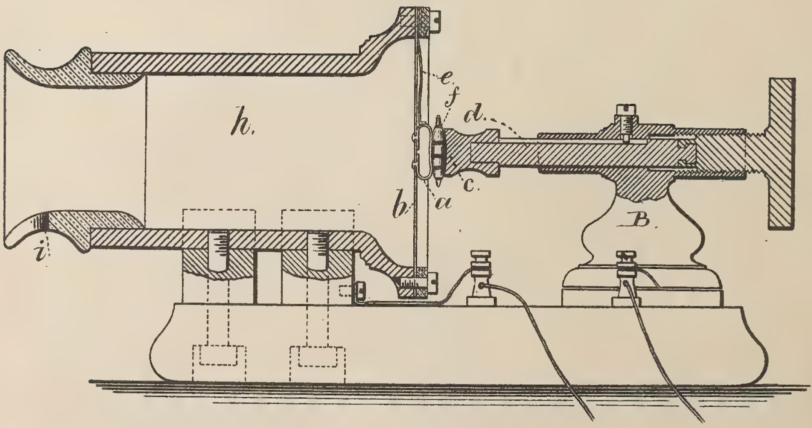
Witnesses:

GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.
Speaking-Telegraph.

No. 203,015. Patented April 30, 1878.

Fig. 1.



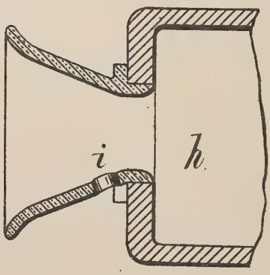


Fig. 2.

Witnesses
Chas H Smith
William G. Mott

Inventor
Thomas A. Edison
per Lemuel W. Serrell
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEGRAPHS.

Specification forming part of Letters Patent No. **203,015**, dated April 30, 1878; application filed August 28, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification:

The object of this invention is to transmit and reproduce the human voice over telegraphic circuits.

The invention, which is a modification of an application for patent filed by me April 27, 1877, consists in the following particulars: A mouth-piece provided with a slot or hole to allow of the escape of the air ejected from the mouth in the act of making a hissing consonant, thus preventing a bulging of the diaphragm, and at the same time increasing in a surprising manner the movement of the diaphragm when such hissing sounds are made.

The invention further consists in the employment of mica as a diaphragm. I have discovered that of many substances which are suitable for diaphragms, it alone will give the greatest amplitude of vibration with the least harmonical or extra sound; that it remains unaffected by the heat and moisture of the mouth, and does not get out of adjustment by stretching, like thin substances that have heretofore been used for diaphragms.

The invention further consists in a yielding contact plate-spring secured to the diaphragm so as to allow the diaphragm to make its full vibration while such spring is pressing against the tension-regulator next referred to.

The invention further consists in a tension-regulator made of elastic fiber and electric conducting material, whereby the resistance of the circuit is decreased by the compression of the fiber, bringing the conducting material into more intimate contact, or the resistance is increased by the expansion of the fiber.

In my application No. 141, filed July 20, 1877, a piece of plumbago is described for varying the resistance by pressure, and I have shown a piece of plumbago arranged in front of a diaphragm operated by the human voice, and connected with the telegraphic line in such a manner that when the diaphragm went outward it would cause pressure upon the plumbago, and this would increase the electric wave in the circuit, and if the diaphragm was vibrated weakly a light pressure would be placed on the plumbago, and a weaker wave would be sent, thus producing waves of a strength proportional to the tones of the voice. This does not give as perfect articulation as the tension-regulator I am about to describe, principally on account of the great difference in pressure, or greater amount of pressure required to effect a given change. I have discovered that if any fibrous material—such as silk, asbestus, cotton, wool, sponge, or feathers—be coated, by rubbing or otherwise, with a semi-conducting substance, such as plumbago, carbon in its conducting form, metallic oxides, and other conducting material, and such fiber be gathered into a tuft and placed in a circuit, it is very sensitive to the slightest movement. I am enabled not only to obtain the regulation by the greater or less pressure, but also to increase or decrease the extent of surface-contact between the particles of conducting or semi-conducting material that is associated with the fiber.

It is best to use fibers that are springy, such as sponge or silk, so as to prevent the materials packing and the regulator losing its elasticity.

I prefer to use unspun silk fiber, cut in lengths of about one-sixteenth of an inch, which are then coated with plumbago by thorough rubbing, or by using a mucilaginous paste of plumbago, rubbing and thoroughly drying, after which the fiber, with a little loose plumbago, is rolled into a cigar shape, and retained by a binding-fiber of silk. I propose to call these "articulators" or "electric tension-regulators."

Another method of metallizing the fiber which I propose to employ is to soak the fiber in a solution of nitrate of silver or other metallic salt, and reduce the metal to a metallic state upon the fiber by a suitable reducing agent, such as exposing the silk to the fumes of phosphorus, this process of metallization being well known among electroplaters for causing non-conducting articles to become conductors for receiving a deposit of metal thereon.

The fiber may be moistened with a semi-

conducting fluid, and operate in precisely the same manner, the resistance being lessened by compressing the fiber, and vice versa.

The electric tension-regulator *f*, I place between a conducting-spring, *a*, secured to the diaphragm *b*, and the conducting point or plate *c*, secured to the adjusting-post *d*, and adjust it so that when the diaphragm is in a state of rest the regulator will remain in contact with both *a* and *c* by pressure. This tension-regulator may be employed in various electric instruments—such as rheostats—to regulate the electric current passing at a given place according to the pressure exerted upon the mass of fiber.

In the drawing, Figure 1 is a section of a transmitting-instrument with my improvements applied thereto. Fig. 2 is a modification of the mouth-piece.

The line-circuit passes to the spring in the center of the diaphragm by the platina foil *e;* thence through the articulator or tension-regulator *f* and contact *c* to the pillar B; thence to battery and earth or return wire.

At the distant station the line enters any suitable receiving-instrument, which may be an electro-magnet secured to a resonant box or operating-diaphragm operated by the armature or other device.

The plate *a* is attached firmly to the mica diaphragm or tympan *b* by making small holes in the mica and soldering the plate to the mica, the solder entering the holes and adhering by the roughness of the surfaces of such holes.

When the diaphragm on the transmitter is in a state of rest, the circuit is closed, and a constant but weak current passes through the circuit, the tension-regulator offering, say, two thousand ohms resistance.

If the slightest sound is made near the mouth-piece, the diaphragm is set vibrating, and the fibrous regulator is compressed and expands at each vibration, thereby increasing and decreasing its resistance many ohms, and causing a rise and fall of tension within the circuit, and these waves so produced act upon the distant receiving-instrument, when these vibrations are reproduced.

In speaking into the case *h*, or into the resonant-box of any telephone, there is difficulty in transmitting the sounds from consonants, because the hissing sound produces a pressure upon the diaphragm instead of a vibration. I obviate this difficulty by an opening in the speaking-tube with an edge or angle, against which the hissing sound is directed, and which responds to such sound, and communicates the same to the diaphragm; and as this hissing sound, in pronouncing some of the consonants, passes downwardly from the mouth, I introduce a notch or orifice, at *i*, in the lower part of the speaking-tube *h*, so that, the sound passing down through the slot and striking the sharp edges of the slot, the hissing sounds are intercepted and cut and turned into vibrations, and these, acting upon the diaphragm, increase enormously the distinctness and volume of the hissing sounds at the receiving-instrument.

In speaking-tubes where there is no slot the air ejected in pronouncing hissing consonants, having no escape, causes the diaphragm to bulge outward, and so lessen the resistance of the circuit, and not transmit the hissing sounds except when exceedingly loud. A large hole in the tube near the diaphragm prevents the bulging of the diaphragm; but it does not increase the effect of the hissing sounds, but on the contrary weakens them, as well as the vowel-sound.

It is obvious that many modifications of the mouth-piece may be made so long as the holes or slots are located so that their edges cut the hissing sounds for the purpose set forth. A tube with a hole or slot, *i*, having a sharp edge between the mouth-piece and diaphragm, as in Fig. 2, may be used.

I have found that mica, owing to its being composed of innumerable layers of thin sheets, does not give a ringing sound or harmonics like most other substances which have equal strength, rigidness, &c., especially metals, and it is not affected, except in an unimportant extent, by the heat and moisture from the mouth; neither does it stretch like metal. All these properties are essential in a speaking-telegraph for insuring permanency and absence of false vibrations or harmonic responses, and for obtaining perfect articulation.

Animal membranes are inconstant, and are too sensitive to heat and moisture, and are constantly stretching. I use a spring in the center of the diaphragm, which is somewhat weaker than the diaphragm, and this is for the purpose of allowing the diaphragm to have a more free movement, the spring serving to take up by its elasticity the effect of the sudden check of the diaphragm when the fiber has been compressed too greatly by loud speaking.

The adjusting-post *d*, by preference, is made so that the disk is brought toward the diaphragm without being turned, so as to prevent disturbing the fibrous tension-regulator.

It is obvious that many devices (other than the mere pressure of the diaphragm against the conducting-fiber) may be used to secure the fiber.

I claim as my invention—

1. In an instrument for transmitting electric impulses by sound, a diaphragm or tympan of mica, substantially as set forth.

2. In an instrument for transmitting electric impulses by sound, the combination, with a diaphragm or tympan, of an electric tension-regulator of fiber and electric conducting material, substantially as set forth.

3. An electric tension-regulator composed of elastic fibrous and electric conducting material.

4. The combination, in an electric instrument actuated by sound, of a diaphragm or tympan, a conductor, and an electric tension-regulator composed of elastic fiber and electric conducting material.

5. The combination, with an electric tension-regulator composed of fiber and electric conducting material, of a variable presser acting upon such fiber, substantially as set forth.

6. The combination, with a diaphragm or tympan of mica, of an electric conductor and pins of solder passing into holes in the mica to secure said conductor, substantially as set forth.

7. In an instrument for transmitting electric impulses by sound, a resonant case having an opening near the mouth-piece, substantially as and for the purposes set forth.

8. In an instrument for transmitting and reproducing the human voice or other sound, a closed telegraphic circuit containing a battery and compressible elastic material operated by the sound, for increasing and decreasing the resistance to the battery-current, substantially as set forth.

Signed by me this 16th day of August, A. D. 1877.

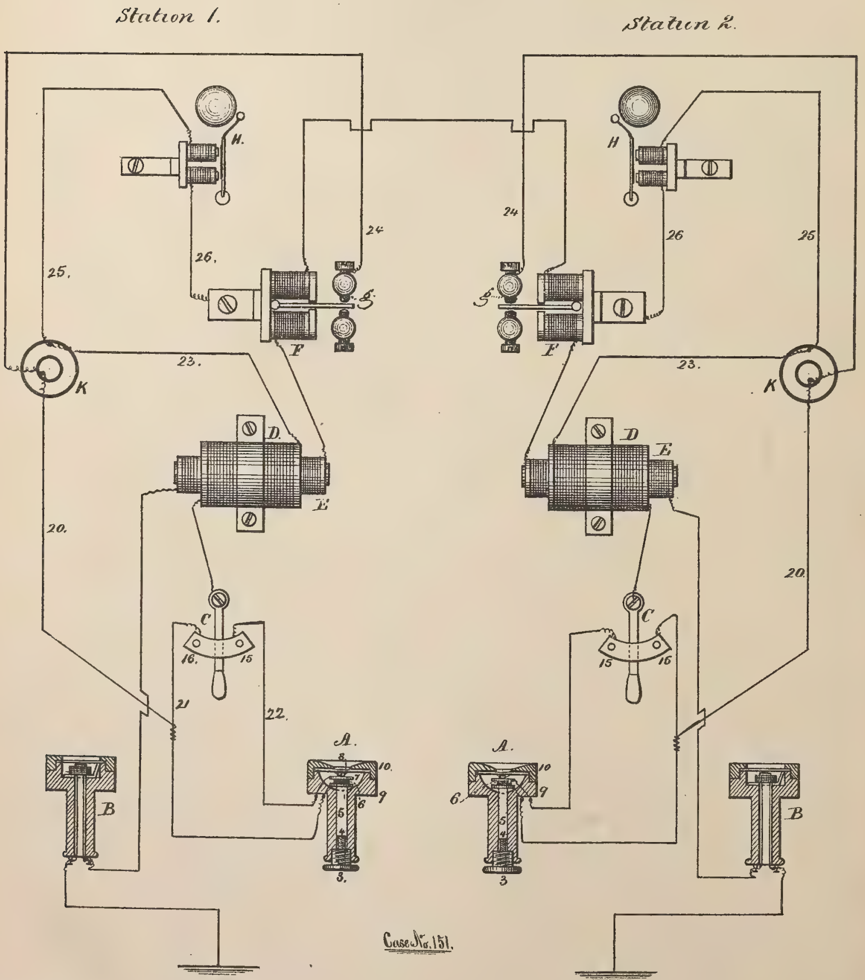
THOS. A. EDISON.

Witnesses:

WILLIAM G. MOTT,
CHAS. H. SMITH.

T. A. EDISON.
Speaking-Telephone.

No. 203,016. Patented April 30, 1878.



Witnesses

Chas. H. Smith

Harold Serrell

Inventor

Thos. A. Edison.

per Lemuel W. Serrell atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEPHONES.

Specification forming part of Letters Patent No. **203,016**, dated April 30, 1878; application filed March 7, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Acoustic Telegraphs, (Case No. 151,) of which the following is a specification:

The object of this invention is to transmit and receive oral communications over telegraphic wire by sound.

The invention relates to an arrangement of devices for transmitting two classes of signals—one by the vibrations of the voice and the other by a key or switch for signaling the distant station.

In my application No. 141 for Letters Patent, filed July 20, 1877, I have shown a carbon disk acted upon by the vibrations of a diaphragm to produce rise and fall of electric tension upon the line, such carbon disk being in the main-line circuit; and in my application No. 146, filed December 13, 1877, I have shown a rheostatic device acted upon by the diaphragm to produce rise and fall of tension in the primary circuit of an induction-coil.

I find that the carbon heretofore employed in connection with a diaphragm is not adapted to use in the primary circuit of an induction-coil, because its resistance is too great, and the necessary rise and fall of tension is not produced.

If the carbon is mixed with other substances, so as to separate the particles, the rise and fall of tension can be obtained; but its resistance is too great to be used in the primary circuit of an induction-coil.

I have discovered that lamp-black obtained from the combustion of very light hydrocarbons, such as gasoline or naphtha, can be used for the aforesaid purpose.

I select from lamp-black thus made only the very blackest portions, and then place the same in a mold, and subject it to a very powerful pressure, sufficient to consolidate the same, and place it in a correspondingly-shaped cavity contiguous to the diaphragm, with a piece of cork or a piece of rubber intervening between the same and the diaphragm, and connect the disks of platina foil that are used at each side of the carbon in the primary circuit of the induction-coil, and obtain from the pressure resulting from the motion of the diaphragm the necessary rise and fall of tension without the great resistance heretofore inseparable from the carbon in said circuit.

I will now describe the action of the apparatus.

A at station 1 is the carbon-transmitter. 9 is the body of the telephone. 10 is the cap for securing the diaphragm tightly. 8 is a piece of cork and rubber tube secured to the diaphragm. The rubber tube rests, when properly adjusted for speaking, against an ivory disk, 7. The ivory disk rests upon a disk of platina foil resting upon a button of lamp-black carbon, 6. This, in its turn, rests upon the platinized surface of the rod 5, which is adjustable to and from the diaphragm by the right and left hand screws 3 and 4.

The platina on the top of the carbon disks next to the diaphragm is connected to a binding-post, and to the other binding-post a wire connects with the rod 5. Thus the circuit must first pass to the upper platina and through the carbon to the lower plate.

The vibrations of the diaphragm subject the carbon to different pressures, according to the amplitude of motion resulting from the sound-waves, and this difference of pressure varies the resistance offered by the carbon to the passage of the current, and produces a rise and fall of electric tension.

The instrument A is included within the primary circuit of the induction-coil D E. D is the primary wire of the coil, and is wound on the outside of the secondary coil E. C is a switch, which, when moved to the right in contact with 15, places the transmitter A in the primary circuit containing the battery K and coil D. When the switch is in the center, the primary circuit is open and the apparatus is ready for the reception of a call-signal. When the switch is turned to the left, at 16, the instrument A is thrown out of circuit, and the battery only is connected to the primary coil D.

The movement of the switch from 16 several times serves to open and close the primary circuit and throw a powerful induced current into E, and then to the line.

The polarized relay F, coil E, and receiving-

instrument B are all placed in the main-line wire at both stations. The powerful current thrown into the secondary coil and line by the movement of the switch C from 16 works the tongues of both polarized relays F in unison with the switch. The tongues, closing against their contact-points, close a local circuit containing a call-bell, H.

The same battery K that is employed with the telephones is utilized to ring the bell. The connections for the transmitter A are from the battery K, by wire 20, to 21, then through the telephone A to wire 22, and from 22 to 15, through the switch-lever C, to the primary coil D and to wire 23, back to battery. This is the connection for transmitting and receiving telephonically. When not thus working, the switch C is placed in the central position between 15 and 16. When in this position, if the switch of the distant station is moved to operate the call, the tongue of F closes the local circuit at *g;* thence, by wire 24, to battery K, and through K to wire 25; thence through the magnets of the bell-call to wire 26, and then through the tongue of the polarized relay.

When the switch C is moved to work the distant call it is brought into contact with 16, and the current passes from K, by wire 20, to 16; thence through C to the primary wire D; thence to 23, back to the battery K, setting up a powerful induced current in the coil E and line.

I will mention that it is not necessary to use a polarized relay, as an unpolarized relay of the ordinary character may be used, as the current due to the opening of the primary circuit is much the strongest; but the lever of the unpolarized relay should be light and the spool very short. It is not even necessary to use the call-bell H in many instances, when the terminal is very quiet, as the sound given by the polarized relay itself is sufficient; or a small bell may be worked by the tongue.

The tongue of a polarized relay should be biased, so that it will always be away from the point *g*, except when moved by the signaling-currents, so as to prevent short-circuiting the battery K when transmitting telephonically.

By employing two cells and a considerable resistance in the magnets upon the call-bell, it is not essential to bias the tongue; but it may be made to respond to both positive and negative, a shunt from one cell being used to furnish current to the call-bell.

I claim as my invention—

1. The combination of transmitter A, coils D E, switch C, polarized relay F, bell H, battery K, and circuits, arranged and operating substantially as herein set forth.

2. In combination with a telephonic and the primary circuit of an induction-coil, the button of lamp-black carbon, prepared as set forth, and placed in the primary circuit, substantially as and for the purposes set forth.

Signed by me this 28th day of February, A. D. 1878.

THOS. A. EDISON.

Witnesses:
HAROLD SERRELL,
GEO. T. PINCKNEY.

T. A. EDISON.
Telephone Call-Signal.

No. 203,017. Patented April 30, 1878.

Fig. 1.

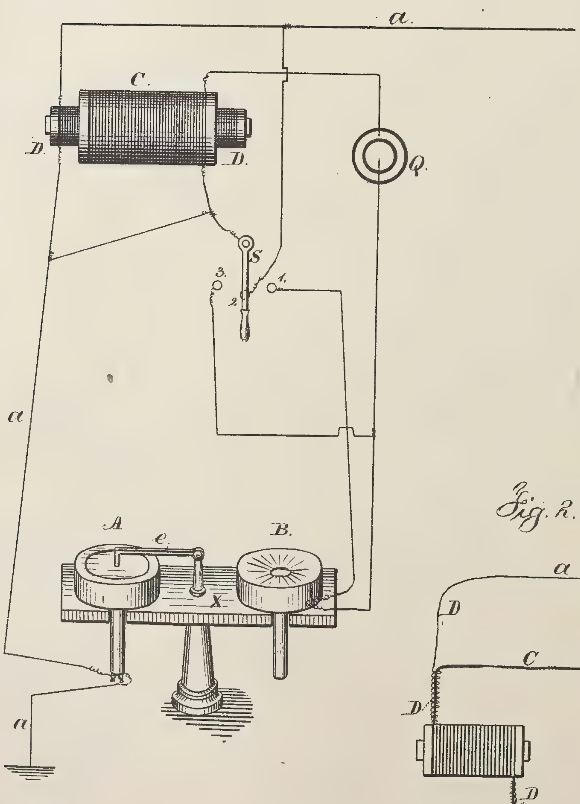
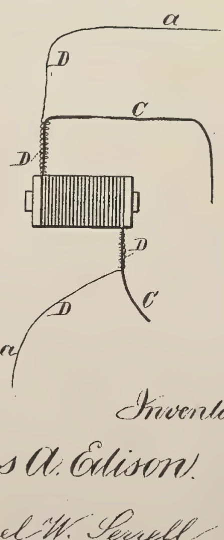


Fig. 2.



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison.
per Lemuel W. Serrell
atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN TELEPHONE CALL-SIGNALS.

Specification forming part of Letters Patent No. **203,017**, dated April 30, 1878; application filed March 4, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Telephone-Calls, (Case No. 152,) of which the following is a specification:

The object of this invention is to provide a simple apparatus for a signal-call on a telephonic circuit.

The invention consists in a stand for the receiving-instrument and a swinging metal lever, the end of which comes into contact with the diaphragm, so that it is thrown from it violently when a strong wave or current passes over the line or through the magnet of the receiving-instrument. This lever, in returning, strikes the diaphragm a blow, and produces a sharp penetrating sound like that of a Morse sounder, and this may be heard in all parts of a large room.

I have heretofore shown, as in Case No. 146, an induction-coil in connection with a telephone. I arrange a switch between the local and main-line circuits, in such a manner as to vary the electric tension on the line by moving such switch, and thereby operating the call at the distant station; and I prefer to employ a peculiarly-constructed induction apparatus, in which there is a fine wire wound helically around a larger wire, and then the two are wound to form a helix. The larger wire is in the local circuit, and forms the primary induction-coil, and the induced current is set up in the finer helix.

If a soft-iron bar passes through the coil, its inductive force is increased; but the clearness of the sound received upon the telephone is lessened thereby.

In the drawing, Figure 1 is a diaphragm of the circuit-connections, and Fig. 2 shows the induction-coil separately.

A is the receiving-instrument, provided with a diaphragm and a magnet for giving motion to it. This is included in the main line *a a a a*.

C is the primary coil; D, the secondary coil, which latter is included in the main-line circuit. *e* is the sounder-lever, resting upon the diaphragm of A. X is a rack or stand for holding both the receiving and transmitting instruments when not in use. S is a switch. When it is turned to the point 1, the transmitter B is included in the primary circuit with coil C and battery Q, and the transmitter serves to increase and decrease its resistance when the diaphragm is vibrated by sound.

There is a carbon disk, through which the current passes, and it produces more or less resistance, according to the amplitude of vibration of the diaphragm, causing greater or less pressure on the carbon.

When the switch-lever S is moved to the point 2, the secondary wire of the coil is short-circuited. It remains in this position for the reception of a call-signal from the distant station. Were the coil D left in circuit it would tend to weaken the signal-call by its resistance to the passage of the current from the distant station.

When the switch-lever is at the point 3, the current from the battery Q passes only through the primary wire. By connecting and disconnecting the switch S from this button 3, powerful induction-waves are thrown into the line, and act upon the distant receiver to attract and repel the lever *e* and give the signal-call.

Fig. 2 illustrates the construction of my improved induction-coil. In this the large wire C forms the primary coil, and the fine wire D, wound around the same, forms the secondary coil, the latter being placed in the main circuit and the former in the local circuit, as heretofore explained.

I claim as my invention—

1. In combination with a receiving telephone-instrument having a diaphragm and electro-magnet, a swinging lever placed with its moving end in contact with the receiving-diaphragm, and a switch or key for increasing the electric current and operating the lever as a sounder or call upon the diaphragm, substantially as set forth.

2. In combination with the telephone-transmitter B and receiver A, the induction-coil C D, battery Q, local circuit, switch S, and

circuit-connections, substantially as and for the purposes set forth.

3. In combination with the main-line circuit and local circuit, and the telephonic instrument, the induction-coil composed of two wires, the largest of which is surrounded by a finer insulated wire wound helically, the two being then wound into a helix to form the induction-coil, substantially as set forth.

Signed by me this 28th day of February, A. D. 1878.

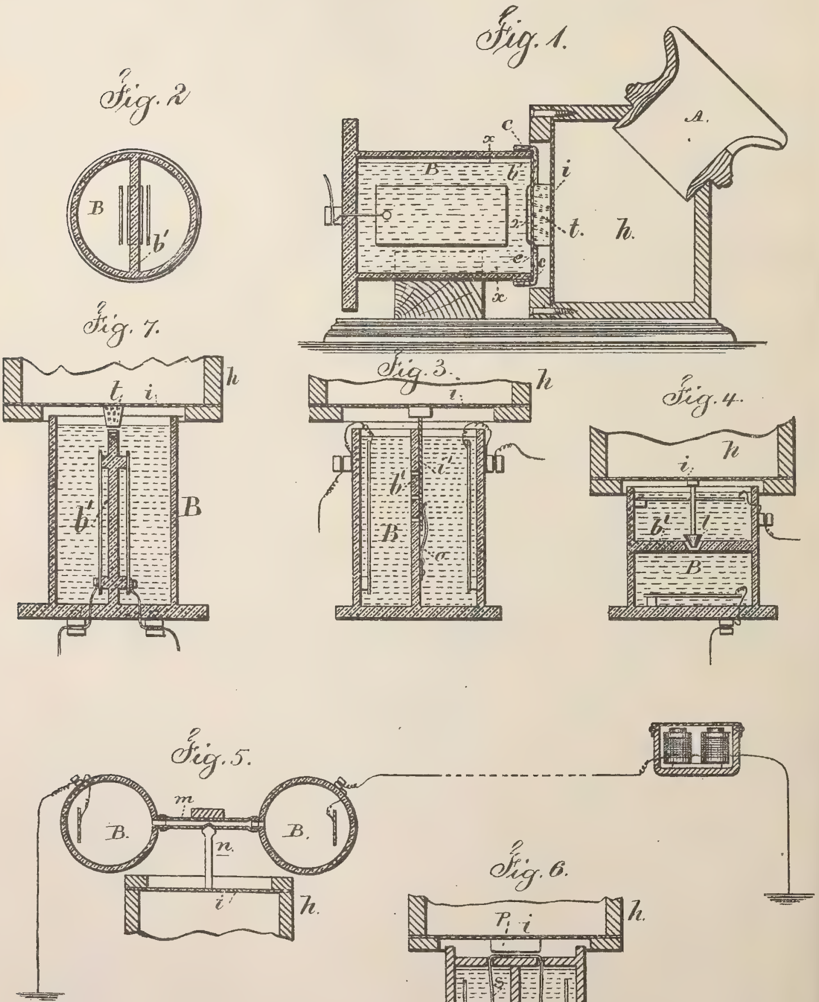
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Telephone or Speaking-Telegraph.

No. 203,018. Patented April 30, 1878.



Witnesses

Chas H. Smith

Geo. T. Pinckney

Inventor

Thomas A. Edison.

per Lemuel W. Serrell atty

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN TELEPHONES OR SPEAKING-TELEGRAPHS.

Specification forming part of Letters Patent No. **203,018**, dated April 30, 1878; application filed December 13, 1877.

To all whom it may concern:

Be it known that I, Thomas A. Edison, of Menlo Park, in the State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification.

I make use of two or more cells containing a mobile fluid, and these fluids are insulated from each other, except when they come together at a narrow opening or space, and there is an electrode in each cell, and the diaphragm or other body vibrated by the atmospheric sound-waves regulates the opening or the pressure at this point, so as to vary the electric tension on the line to correspond with the sound-vibrations.

In the drawings, Figure 1 is a vertical longitudinal section of an acoustic transmitter fitted with my improvement, and Fig. 2 is a cross-section at the line *x x*.

B is a cylinder of insulating material, divided by a partition, *b′*, into two compartments or cells filled with a conducting-fluid. In each cell is an electrode of platina, carbon, or other conductors, one of which is connected to the line-wire and the other to the battery and earth. The top portion of the partition *b′* is slightly hollow, leaving a passage-way, 2, for the fluid and current to circulate from one cell to the other.

Resting upon the face of the cylinder is a flexible head of mica, rubber, or other non-conducting material, *e*, impervious to the fluid, and over this is secured a cap, *c*, provided with a slot. When the cap *c* is securely fastened to the cylinder the diaphragm prevents any of the fluid from circulating from one cell to the other, except through the small aperture at 2 made by the curve on the end of the partition *b′*.

h is a box with a mouth-piece, A, and at one side of the box is secured the diaphragm *i*, and upon the diaphragm is a piece of cork, *t*, which extends outward from it and through the slot in the cap *c* on the head of the cylinder B, and comes in contact with the mica or rubber flexible heads, to which it may be secured by a cement, although this is not actually necessary.

The operation is as follows: When the diaphragm *i* is properly adjusted to the diaphragm in the cylinder B the space for the circulation of the fluid from one cell to the other is very narrow. If, now, the diaphragm is set in vibration by a sound, the passage-way is increased and decreased in size at every vibration, thus increasing and decreasing the resistance to the passage of the current from one cell to the other, owing to the alteration in the size of the liquid conductor. If the amplitude of the diaphragm is very great, the space is nearly, if not altogether, closed at the forward movement, and widened to its fullest extent by the backward motion, and if the amplitude is small only a slight increase and decrease in size of the aperture takes place. According to the size of the opening, so there will be more or less resistance to the current passing through at this point, and there will be a corresponding rise and fall of electric tension on the line at this point.

It is obvious that with a mobile fluid all the harmonical and other sounds incident to articulation act to produce corresponding changes of electric tension.

The opening that connects one cell with the other is small, and at the side of the electrodes, in preference to being above them; hence the gas formed by decomposition of the fluid from transmitting does not interfere with the operation nor produce extra sounds, and at the same time a great increase and decrease in the strength of the current is effected by the slightest movement of the diaphragm.

There are many forms of apparatus in which my improvement may be employed.

In Fig. 7 the cylinder B is represented as standing vertically instead of horizontally, as in Fig. 1, which permits of the diaphragms *e* and *c* being dispensed with.

In Fig. 3 I have represented several narrow slits in the partition *b′* between the cells, and a thin strip of metal, *i′*, from the diaphragm *i* running down at the side of the partition, and also slotted; but the slots in the normal position do not correspond; hence by the vibration of the diaphragm the openings are increased

or lessened and the resistance to the electric current increased or decreased. A spring, *o*, may be used to hold the plate to the partition.

Fig. 4 shows the partition *b′* arranged horizontally, the passage-way from one cell to the other being controlled by a valve or plunger, *l*, arranged at an aperture through the partition.

In Fig. 5 the passage-way is between two independent cells by means of a flexible tube, *m*, and the opening is increased or lessened by the movement of the diaphragm acting through a finger, *n*, that presses upon the flexible tube.

I will mention that mercury may be used instead of an electrolyte, or a porous material, such as paper, may serve to connect the cells together, as in Fig. 6.

s represents a piece of porous material, such as paper or muslin, and the ends pass into liquid in the cells, so as to be kept moist by capillary attraction, and adjacent to this is a presser, *p*, connected to the diaphragm or other vibrating body, so as to be moved by the same and press with more or less force upon the moistened strip and interrupt the passage of electricity more or less, according to the amplitude of vibration.

I do not herein claim a mica diaphragm, the same being set forth in my prior application No. 143, filed August 28, 1877; neither do I herein claim a device for effecting a rise and fall of electric tension by a motion derived from the diaphragm, that having been set forth in my prior application No. 130, filed April 27, 1877; and in my application No. 144, filed September 5, 1877, the electrodes are moved to vary the resistance to the electric current passing through a liquid. In the present instance the electrodes are stationary.

I claim as my invention—

In an acoustic-telegraph apparatus, the combination of two stationary electrodes immersed in two cells, a conducting-fluid in said cells, and a fluid-connection between such cells, and mechanism actuated by a sound-vibrated body for varying the dimensions of such liquid-connection and the conductivity of the same, substantially as set forth.

Signed by me this 8th day of December, A. D. 1877.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN TELEPHONES OR SPEAKING-TELEGRAPHS.

Specification forming part of Letters Patent No. **203,018**, dated April 30, 1878; application filed December 13, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification.

I make use of two or more cells containing a mobile fluid, and these fluids are insulated from each other, except when they come together at a narrow opening or space, and there is an electrode in each cell, and the diaphragm or other body vibrated by the atmospheric sound-waves regulates the opening or the pressure at this point, so as to vary the electric tension on the line to correspond with the sound-vibrations.

In the drawings, Figure 1 is a vertical longitudinal section of an acoustic transmitter fitted with my improvement, and Fig. 2 is a cross-section at the line *x x*.

B is a cylinder of insulating material, divided by a partition, *b′*, into two compartments or cells filled with a conducting-fluid. In each cell is an electrode of platina, carbon, or other conductors, one of which is connected to the line-wire and the other to the battery and earth. The top portion of the partition *b′* is slightly hollow, leaving a passage-way, 2, for the fluid and current to circulate from one cell to the other.

Resting upon the face of the cylinder is a flexible head of mica, rubber, or other non-conducting material, *e*, impervious to the fluid, and over this is secured a cap, *c*, provided with a slot. When the cap *c* is securely fastened to the cylinder the diaphragm prevents any of the fluid from circulating from one cell to the other, except through the small aperture at 2 made by the curve on the end of the partition *b′*.

h is a box with a mouth-piece, A, and at one side of the box is secured the diaphragm *i*, and upon the diaphragm is a piece of cork, *t*, which extends outward from it and through the slot in the cap *c* on the head of the cylinder B, and comes in contact with the mica or rubber flexible heads, to which it may be secured by a cement, although this is not actually necessary.

The operation is as follows: When the diaphragm *i* is properly adjusted to the diaphragm in the cylinder B the space for the circulation of the fluid from one cell to the other is very narrow. If, now, the diaphragm is set in vibration by a sound, the passage-way is increased and decreased in size at every vibration, thus increasing and decreasing the resistance to the passage of the current from one cell to the other, owing to the alteration in the size of the liquid conductor. If the amplitude of the diaphragm is very great, the space is nearly, if not altogether, closed at the forward movement, and widened to its fullest extent by the backward motion, and if the amplitude is small only a slight increase and decrease in size of the aperture takes place. According to the size of the opening, so there will be more or less resistance to the current passing through at this point, and there will be a corresponding rise and fall of electric tension on the line at this point.

It is obvious that with a mobile fluid all the harmonical and other sounds incident to articulation act to produce corresponding changes of electric tension.

The opening that connects one cell with the other is small, and at the side of the electrodes, in preference to being above them; hence the gas formed by decomposition of the fluid from transmitting does not interfere with the operation nor produce extra sounds, and at the same time a great increase and decrease in the strength of the current is effected by the slightest movement of the diaphragm.

There are many forms of apparatus in which my improvement may be employed.

In Fig. 7 the cylinder B is represented as standing vertically instead of horizontally, as in Fig. 1, which permits of the diaphragms *e* and *c* being dispensed with.

In Fig. 3 I have represented several narrow slits in the partition *b′* between the cells, and a thin strip of metal, *i′*, from the diaphragm *i* running down at the side of the partition, and also slotted; but the slots in the normal position do not correspond; hence by the vibration of the diaphragm the openings are increased

or lessened and the resistance to the electric current increased or decreased. A spring, *o*, may be used to hold the plate to the partition.

Fig. 4 shows the partition *b′* arranged horizontally, the passage-way from one cell to the other being controlled by a valve or plunger, *l*, arranged at an aperture through the partition.

In Fig. 5 the passage-way is between two independent cells by means of a flexible tube, *m*, and the opening is increased or lessened by the movement of the diaphragm acting through a finger, *n*, that presses upon the flexible tube.

I will mention that mercury may be used instead of an electrolyte, or a porous material, such as paper, may serve to connect the cells together, as in Fig. 6.

s represents a piece of porous material, such as paper or muslin, and the ends pass into liquid in the cells, so as to be kept moist by capillary attraction, and adjacent to this is a presser, *p*, connected to the diaphragm or other vibrating body, so as to be moved by the same and press with more or less force upon the moistened strip and interrupt the passage of electricity more or less, according to the amplitude of vibration.

I do not herein claim a mica diaphragm, the same being set forth in my prior application No. 143, filed August 28, 1877; neither do I herein claim a device for effecting a rise and fall of electric tension by a motion derived from the diaphragm, that having been set forth in my prior application No. 130, filed April 27, 1877; and in my application No. 144, filed September 5, 1877, the electrodes are moved to vary the resistance to the electric current passing through a liquid. In the present instance the electrodes are stationary.

I claim as my invention—

In an acoustic-telegraph apparatus, the combination of two stationary electrodes immersed in two cells, a conducting-fluid in said cells, and a fluid-connection between such cells, and mechanism actuated by a sound-vibrated body for varying the dimensions of such liquid-connection and the conductivity of the same, substantially as set forth.

Signed by me this 8th day of December, A. D. 1877.

THOS. A. EDISON.

Witnesses:

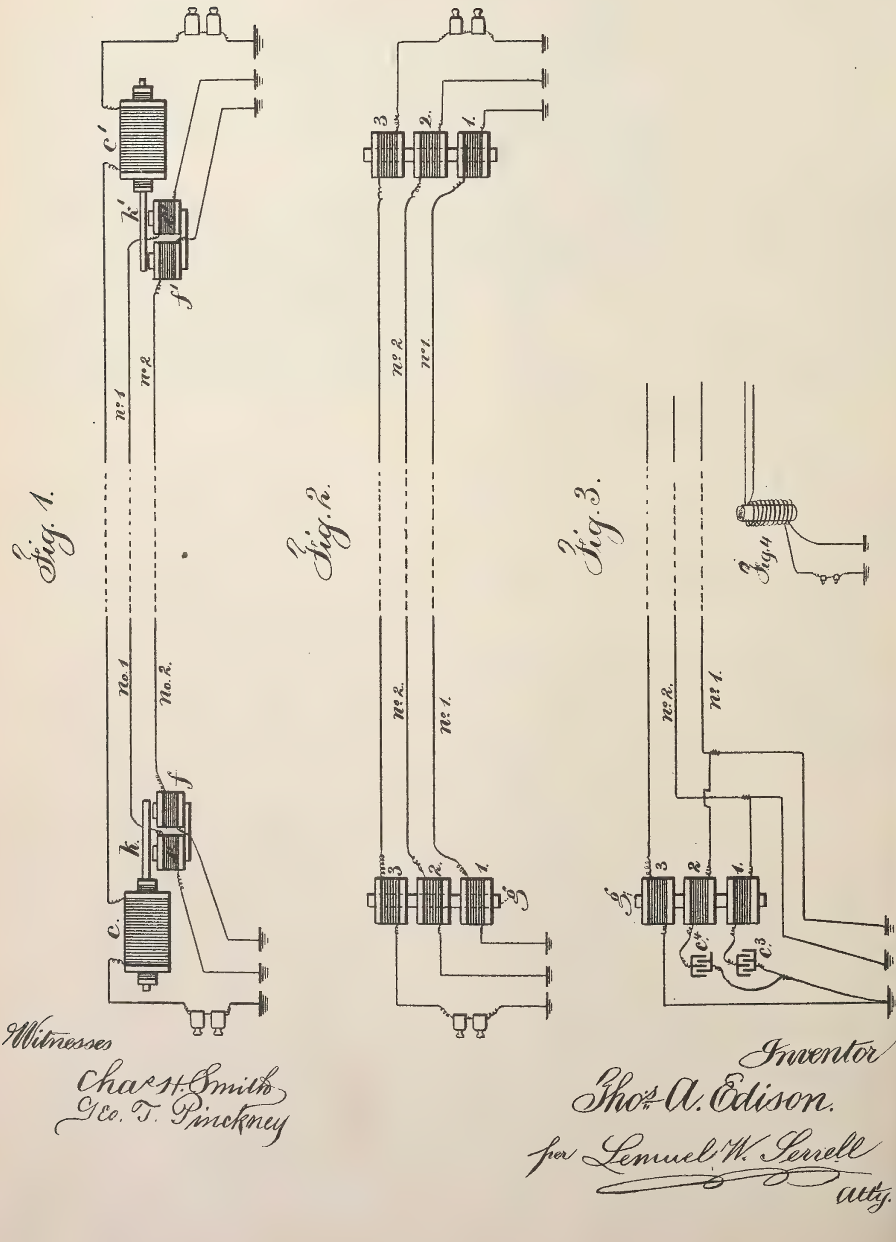
GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Circuits for Acoustic or Telephonic-Telegraph.

No. 203,019. Patented April 30, 1878.



Witnesses

Chas. H. Smith

Geo. T. Pinckney

Inventor

Thos. A. Edison.

per Lemuel W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN CIRCUITS FOR ACOUSTIC OR TELEPHONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **203,019**, dated April 30, 1878; application filed February 21, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Circuits for Acoustic Telegraphs, (Case No. 150,) of which the following is a specification:

In telegraph-lines there are very often numerous wires running in the same direction upon the poles, and it has long been known that currents passing through one or more of said wires set up induced currents in the other wires. These ordinarily are harmless in the Morse and other systems of telegraphy; but where a wire for a telephone, acoustic, or speaking telegraph runs parallel to or within the field of the electric influence of another wire, there are false and confusing sounds at the receiving-instrument that greatly interfere with hearing the message sent upon such acoustic lines.

The object of the present invention is to compensate, neutralize, and destroy the extraneous or induced currents from contiguous circuits, so that the messages will not be in any manner interfered with by false currents.

The invention is primarily adapted to telephonic circuits, and is so described herein; but it may be used with any instruments where it is desirable to neutralize such extraneous currents.

The present invention consists in the combination, with the telephonic circuit or other circuit to be freed from external influences, of an induction-coil, connected with the contiguous circuits in such a manner that a reactionary induction is established in the telephonic line of a power corresponding and similar to the primary inductive action, but opposed to the same, so as to entirely oppose and neutralize the action of the same.

In the drawing, Figure 1 is a diagram representing one of the forms in which the aforesaid compensation is effected. The large coils c c' are included in the telephonic circuit at each end of the line. In the coils are iron cores, surrounded by a primary coil, the ends of which may or may not be connected together, according to the compensation desired.

The iron core extends outside of the coils some distance. I have shown compensation for two circuits only. These circuits, which I call "No. 1" and "No. 2," running in close proximity to the telephone-wires for many miles, induce a momentary current in it every time the circuits are opened or closed, the strength of which is proportionate to the proximity of the wires to each other and the number of miles that they run side by side.

These induced currents are in one direction in closing the circuit, and the opposite direction on opening the circuit. To neutralize the induced current from, say, No. 1 circuit, I place electro-magnets e e' at each terminal in the circuit of circuit No. 1.

These magnets are then adjusted to approach the iron cores k k' until the induced current thrown into the coils c and c' and telephone-line by the action of the magnets e and e' is equal, but opposite to, the induced current from the circuit No. 1 thrown into the telephonic wire by running parallel to it. Thus a perfect compensation is attained.

If the two lines run parallel for long distances I connect the two ends of the primary coil on c and c' together, and thus retard the magnetism and demagnetization of the cores k k', and consequently lengthen the induced currents thrown into c and c' by the action of e' and e.

Having thus compensated for circuit No. 1, the compensation for circuit No. 2 is exactly similar. If the latter circuit does not affect the telephone-circuit as strongly as No. 1, the electro-magnets f and f' are placed a greater distance from k and k'; the latter may be elongated, and compensation attained from many circuits by employing separate magnets in each circuit which affects the telephonic circuit.

Owing to the great diversity in the character of the induced currents thrown into telephonic wires from wires in close proximity—due to different lengths and the employment of different battery powers and systems of transmission—many methods to meet special conditions are necessary. Thus in Fig. 2, where the circuits 1 and 2 employ powerful batteries and reversals and many magnets are in circuit, the induced currents thrown into the tele-

phonic wire are exceedingly powerful; hence a more powerful means of compensation is necessary.

In Fig. 2, g is an iron core, over which there are three or more coils—one for each line-circuit. The coils 1 and 2 are in the ordinary or Morse circuits Nos. 1 and 2, while coil 3 is in the telephonic circuit. The coils are so wound and arranged, in relation to the induced currents thrown into the telephone-wire by the proximity of the other wires that they will act in the iron core g to set up a magnetism therein that will cause a powerful induced current to pass into coil 3 and telephonic line opposite in direction to the induced currents in the telephonic line due to the proximity of the other wires.

It is obvious that these coils may be inserted at any number of points along the line, and that the intensity of the reverse currents will be proportionate to the intensity of the currents exerting the inductive influence, and hence they will always be neutralized.

In cables containing a number of wires there is not only dynamic induction, but static induction. The latter appears sooner than the former, and is of exceedingly short duration, so that magnetic compensation alone is too sluggish. In Fig. 3 is shown a modification of Fig. 1 to meet this condition, which it does to a considerable extent, but not entirely.

The induction-coils 1 and 2 are included in derived circuits from the line-circuits 1 and 2, that pass to the condensers c^3 and c^4, and to the earth. The object of the condensers is to prevent any leakage of current from the circuits 1 and 2, and at the same time to hasten the magnetizing and demagnetizing of the cores g, so that an induced current of momentary duration is set up in coil 3 to meet and compensate for the static current from the circuits 1 and 2.

I will here mention that, to obtain perfect compensation, both the static and dynamical induced currents must be set up in the compensations so they will circulate in the telephonic wire in a direction opposite to those induced by proximity of the wires; and to obtain these conditions, both magnets and condensers are necessary—the former to set up dynamical induction-currents, and the latter statical currents.

In my apparatus, if current No 1 is opened there first appears a short wave of current due to static induction, then an interval, and then the dynamical inducted current appears, which gradually dies away to nothing; hence, a compensation which will eradicate the dynamical current will leave that due to static induction free to circulate, and this cannot be eradicated by an induced current from a magnet, because time is required to charge and discharge the cores and the consequent production of the induced current.

Upon short circuits I use a coil with two or more wires, wound side by side upon a wooden bobbin, as shown in Fig. 4. One wire is placed in the telephonic circuit, while the others are placed in the circuits to be compensated for, and so connected therewith that the currents thrown into the telephonic coil are equal but opposite to those due to induction resulting from the wires running parallel.

By employing large wires, and a large quantity of it, I am enabled to obtain nearly perfect compensation, as the coils set up both dynamical and statical currents, no iron cores being used to retard the appearance of the currents.

Instead of the coil of several wires wound side by side, several long strips of tin-foil may be placed side by side and insulated from each other, and the currents passed through the strips in the same manner as if they were wires.

Another method consists in providing the telephonic receivers with differential coils, and running another wire parallel with the telephonic wires, and including in it the subsidiary coil.

I claim as my invention—

The method herein specified of compensating in one circuit for induced currents from adjacent circuits, consisting in setting up a reactionary induction by an induction-coil connected with the adjacent circuit or circuits, substantially as set forth.

Signed by me this 13th day of February, A. D. 1878.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Perforating-Pen.

No. 203,329. Patented May 7, 1878.

Fig. 1.

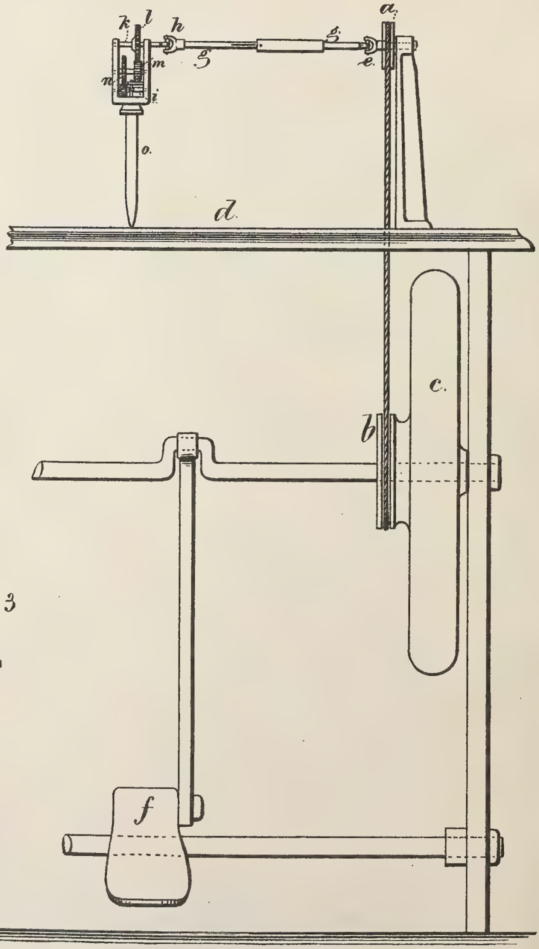


Fig. 2.

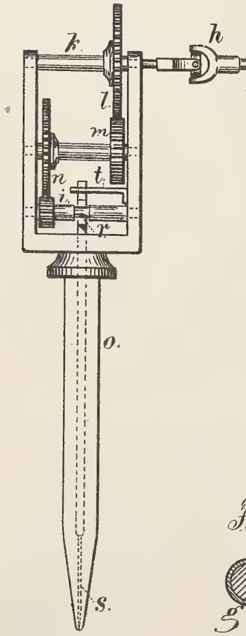


Fig. 3

Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor.

Thomas A. Edison
per Lemuel W. Serrell
Att'y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN PERFORATING-PENS.

Specification forming part of Letters Patent No. **203,329**, dated May 7, 1878; application filed April 23, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Perforating-Pens, of which the following is a specification:

This invention is an improvement upon and modification of the device patented to me, No. 180,857, and dated August 8, 1876.

The present invention relates to a means for reciprocating the needle that is used for perforating the paper.

I employ a motor that is revolved by foot or other convenient power, and gives motion to a shaft with universal joints that passes to the pen and revolves the mechanism that reciprocates the pen, and at the same time the universal joints allow the pen to be manipulated in writing or drawing. It is also preferable to employ a tube and sliding rod extending from one universal joint to the other, that allows the distance to be increased or lessened between the universal joints.

In the drawing, Figure 1 is an elevation, illustrating the connection between the motor and the pen. Fig. 2 is a side view of the pen in larger size; and Fig. 3 is a section of the tubular connection in magnified size.

The wheel *a* is revolved by suitable power. It will generally be preferable to connect the same by a belt with a larger wheel, *b*, and fly-wheel *c*, either above or below the table *d*, actuated by a treadle, *f*.

The universal joint *e* is at one end of the shaft *g*, connecting the same to the shaft of the wheel *a*, and this shaft *g* extends to the universal joint *h* of the shaft *k*. It is preferable to have this shaft *g* in two parts, one a tube, and the other a rod sliding within it, there being a groove or feather (see Fig. 3) that allows the one part to be revolved by the other, and at the same time the distance between the joints *e* and *h* can vary, to adapt the position of the pen to the place where the writing is being performed.

The shaft *i* is revolved with great rapidity by means of the train of gearing *l m n* extending between the shaft *k* and the shaft *i*. The shafts of this train of gearing are supported in the light metallic frame above the tubular pen-holder *o*, within which is the needle *s*, that is reciprocated by a cam or eccentric, *r*, upon the shaft *i*. The guide *t* serves to maintain the upper end of the needle-holder in its proper position. The penetrating needle-point acts, as described in my aforesaid patent, to perforate the paper in drawing or writing, and the subsequent printing from the perforated sheet is to be done in the manner described in said patent.

I claim as my invention—

1. The combination, with an autographic perforating-pen, and the cam or eccentric to operate the same, of the universal joints and shaft *g*, connecting and giving motion from a motor to the mechanism upon the pen, substantially as set forth.

2. The extension-shaft *g*, made in two parts, one sliding within the other, and provided with universal joints at the ends, in combination with a motor and a pen formed of a reciprocating needle, a holder, and mechanism for moving the pen, substantially as set forth.

3. In combination with the autographic perforating-pen, the train of gearing upon the pen to increase the speed of the pen, and a motor connecting with the train of gearing upon the pen, substantially as set forth.

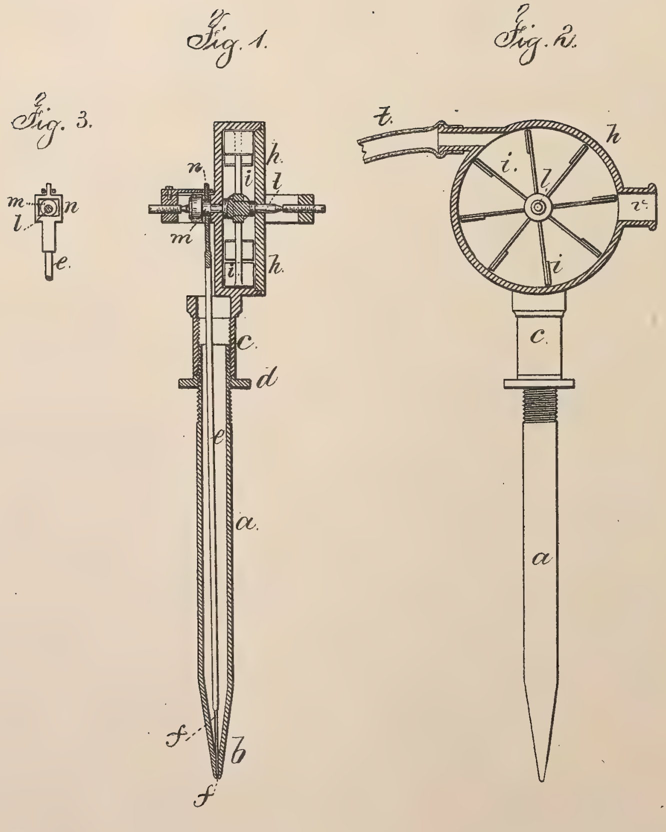
Signed by me this 18th day of April, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Pneumatic Stencil-Pen.

No. 205,370. Patented June 25, 1878.



Witnesses,
Chas. H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison.
per Lemuel W. Serrell
atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN PNEUMATIC STENCIL-PENS.

Specification forming part of Letters Patent No. **205,370**, dated June 25, 1878; application filed March 26, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Autographic Printing, of which the following is a specification:

In Letters Patent granted to me August 8, 1876, No. 180,857, an instrument is described for puncturing paper for use in autographic printing, consisting of a needle-pointed rod moving within a tube or holder, and reciprocated by a cam and shaft actuated by an electro-motor; and a reference is hereby made to said patent for a description of the application of said instrument and the manner of printing from the punctured sheet of paper.

The object of my present invention is to make use of air, gas, water, or other fluid as the motor for actuating the reciprocating needle-rod, whereby I am enabled to reduce the weight of the instrument, and consequently render it more convenient for use.

In the drawings, Figure 1 is a vertical section of the instrument provided with a fan-wheel for the air or other fluid to act on. Fig. 2 is an elevation of the pen-holder and section of the fan-wheel case. Fig. 3 shows the cam for reciprocating the needle-rod.

a is the pen tube or holder, tapering to a point, *b*, at its lower end, and its upper end is screwed into the socket *c* and clamped by the nut *d*. *e* is the needle-pointed rod within the tube or holder *a*, and the needle-point *f* should project slightly below the end of the point *b* when the rod *e* is at its extreme downward movement, so as to puncture the paper and be entirely within the tube at the reverse movement, in order that the pen can be moved in forming the letter or line, all substantially as set forth in the aforesaid patent.

In Figs. 1 and 2, I have shown a case, *h*, upon the socket *c*, and within this case is a fan-wheel, *i*, upon a shaft, *l*, in screw-bearings attached to the sides of said case, and secured to this shaft is a cam, *m*, that acts upon the stock *n* at the upper end of the needle-rod *e*, and reciprocates said rod with more or less rapidity, according to the speed of rotation of the fan-wheel *i*. This fan-wheel may be driven by water admitted to the case *h* through the flexible tube *t* from any suitable supply, such as a connection from a street-main, or from a reservoir properly located, the fluid escaping by the pipe *v* after acting upon the wheel; or air under pressure from a compressing apparatus may be used for driving the fan-wheel; or the flexible tube *t* may be provided with a mouth-piece, so that the person using the instrument may blow into the tube and case, and thus rotate the fan-wheel.

I claim as my invention—

1. In an instrument for puncturing paper for autographic printing, a needle-pointed rod reciprocated by a device constructed substantially as described, and operated by the action of air or other fluid, as set forth.

2. In combination with the holder *a* and needle-rod *e*, the fan-wheel *i*, case *h*, shaft *l*, cam *m*, and flexible tube *t*, substantially as and for the purposes specified.

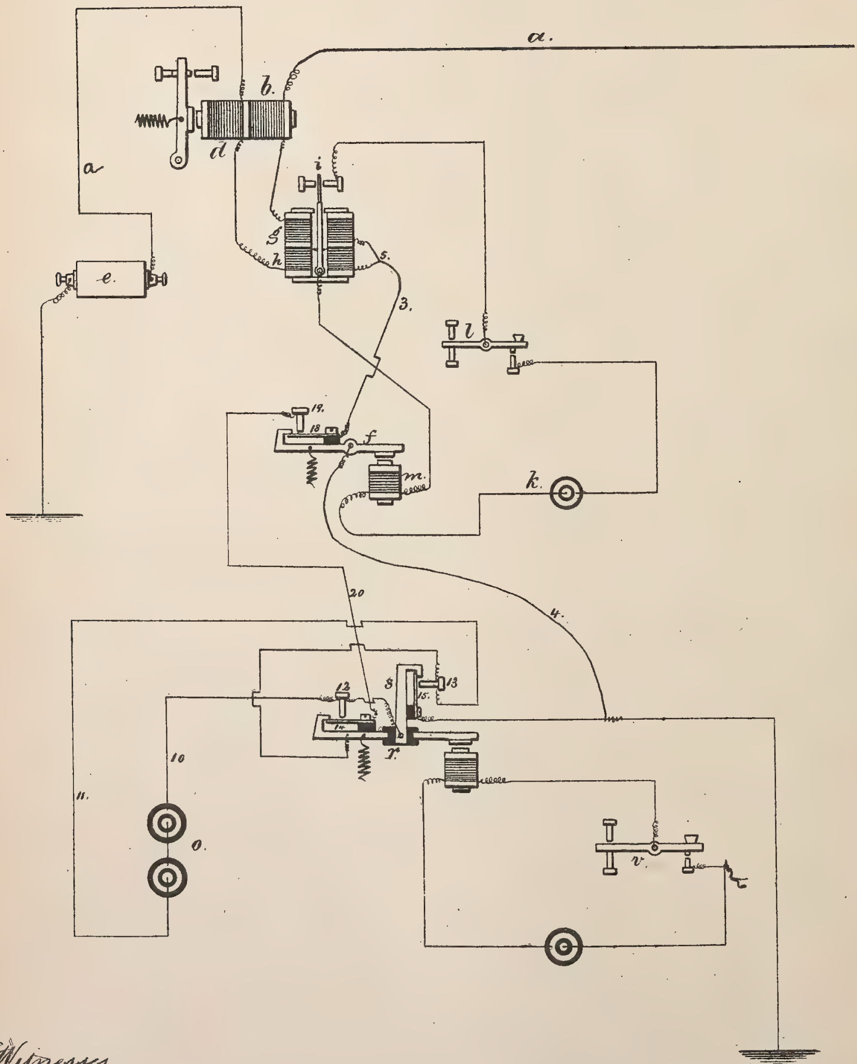
Signed by me this 3d day of February, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Duplex Telegraphs.

No. 207,723. Patented Sept. 3, 1878.



Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thomas A. Edison
per L. W. Serrell
Atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT, OF NEW YORK CITY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **207,723**, dated September 3, 1878; application filed September 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

Where two persons are sending and two receiving, one at each end, the entire line is sometimes deranged by a signal from one of the receivers to repeat. My invention is made to allow either party that is receiving to interrupt the person sending to him, so that he is thereby warned to repeat, and that without interfering with the other message that is being sent or received.

In the diagram drawing, *a* is the line; *b*, the receiving relay-instrument. *d* is a helix around the same core as *b;* and this helix is in a circuit passing to the artificial line and rheostat *e*, and this rheostat is to be adjusted to equal the line, so that the pulsation from the sending-station, acting in reverse in the helices *b* and *d*, produces no magnetizing effect in the core, but the pulsation from the distant station, passing along *a*, acts in *b*, unbalanced, and either produces the sound by the armature-magnet or else works a local circuit and sounder. The pulsation received from the distant station passes by 3, *f*, and 4 to the earth-connection.

The lever *f* is operated to give the pulsations that are sent upon the line, and these pulsations divide at 5, passing equally through the helices *g* and *h*, thence through the helices *b* and *d* aforesaid.

The helices *g* and *h* are of a differential polarized relay, the tongue or polarized armature-lever *i* of which forms a circuit-breaker in the local circuit *k l m*, and in this circuit the key *l* acts to open or close the circuit, and, by the electro-magnet *m*, operate the lever *f* and send the pulsations upon the line.

The main battery *o* is connected by wires 10 11 to closing-points 12 13, and the reversing-lever *r* has springs 14 15 and an insulated arm, *s*. When the key *l* is operated the lever *f* closes 18 and 19, and with the lever *r* in the position shown the circuit is closed by 10 12 *s* 15 to the ground, there dividing, part returning through *e d h* to 3, part going to distant station, thence by *a b g* to 3, whence the united currents pass by 3, 18, 19, 20, 14, *r*, 13, and 11 to the battery. By these connections the pulsations are sent to the distant station and received there in a similar instrument. It will be apparent that at the sending-station the current divides at 5, and, passing through both *g* and *h*, the polarized armature will be retained in the normal position, with the circuit of *k l m* closed, regardless of whether the current sent is reversed or not; but the current from the distant station only acts in *g;* hence the polarized tongue is changed by the reversal of the battery-connection at the distant station, so that if the receiver closes the key *v* he does not interfere with the party sending by the key *l* from his own station, but, the battery-connection being reversed, the differential relay at the distant station is changed by the change of polarity in *g*, and the party sending the message is warned to repeat by the fact that his own magnet *m* does not work, because the polarized tongue has broken the circuit of the magnet *m*, and it will not respond to his key *l*. It is to be remarked that the receiving-operator only closes his key *v* sufficiently long to give the signal, and then releases it, so that the parts resume their normal condition to allow of the message being again sent to him. The reversal of the polarity at the sending-station does not change the balanced condition of *b d*, nor make any difference in the action at the distant station, because that current sent is operative in *b* at the receiving-station, whether of one polarity or the other.

I do not herein claim the construction or arrangement of the reversing lever or key *r*, except in combination with other portions of the apparatus, as hereinafter specified, as the same is fully described in another application of even date herewith, and designated as Case 99.

I claim as my invention—

The differential polarized relay-magnet *g h* and local circuit containing the key *l*, armature-lever *i*, and magnet *m*, in combination with the reversing-key *r* and circuit-connections, substantially as set forth.

Signed by me this 19th day of August, A. D. 1874.

THOS. A. EDISON.

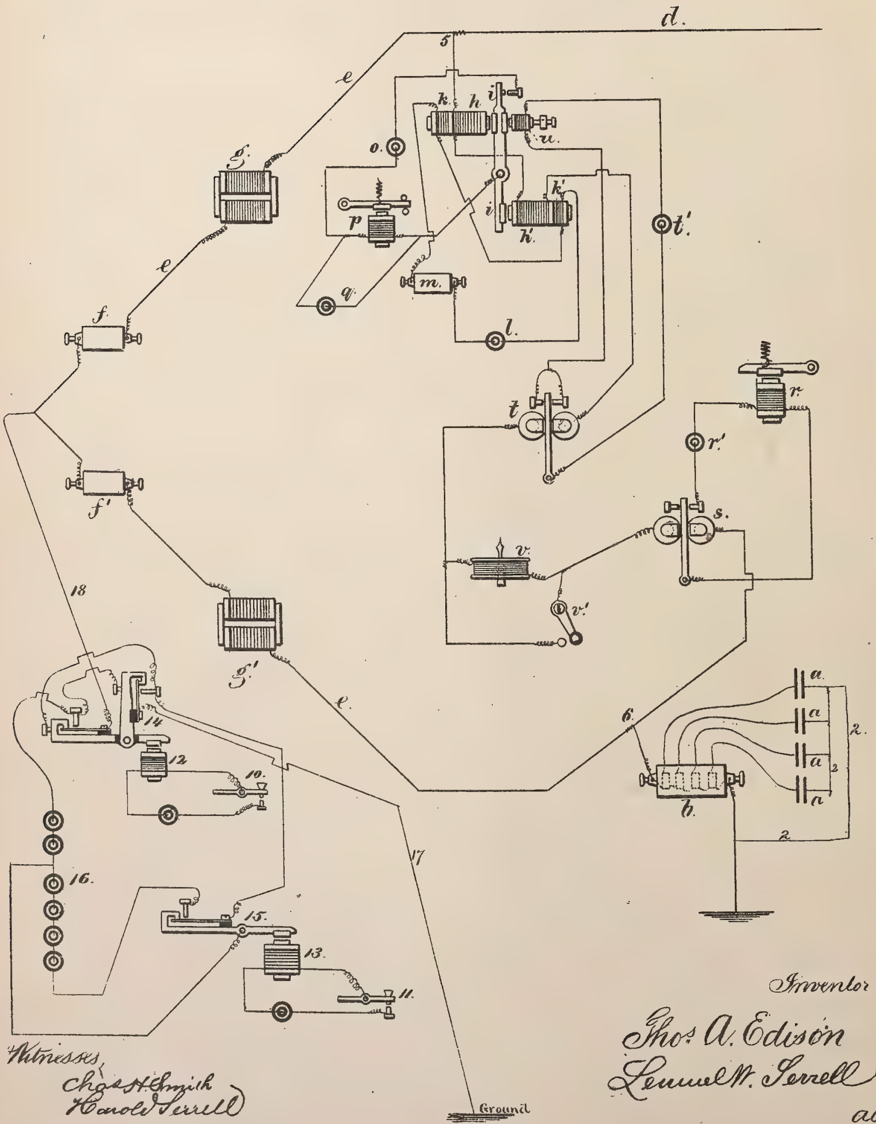
Witnesses:

CHAS. H. SMITH,

GEO. T. PINCKNEY.

T. A. EDISON.
Duplex Telegraph.

No. 207,724. Patented Sept. 3. 1878.



Witnesses,
Chas. H. Smith
Harold Serrell

Inventor
Thos. A. Edison
Lemuel W. Serrell
att'y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **207,724**, dated September 3, 1878; application filed December 28, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

Duplex telegraphs have been made with an artificial line connected to a bridge, and a resistance and condensers have been used in such artificial line; but the artificial line does not properly represent the telegraph-line, and there are inaccuracies in the action of the artificial line arising from the fact that the energy of the current sent is greatest near the sending-station and diminishes toward the receiving-station, and the reaction or static discharge is in the same proportion, the last portion thereof being the weakest; but in the artificial line the condensers discharge so nearly simultaneously that the static discharge from them does not properly balance the static discharge from the line.

The first portion of my present invention relates to the arrangement of the condensers and rheostats composing the artificial line.

The second portion of my invention relates to the combination of a retractile magnet with the armature of the receiving-magnet, the retractile magnet being so arranged as to release its action upon the said armature at the moment of the reversal of polarity of the main battery.

In carrying out the first part of my invention, instead of making use of a single condenser having a static capacity equivalent to that of the line, as has heretofore been the practice, I employ two or more separate condensers, the number depending upon the length of the line, and having an aggregate capacity equal to that of the single condenser heretofore employed.

It is well known that the static capacity, and consequently the charge of a long line, is greatest at the end adjacent to the battery, and decreases progressively from thence to the distant end, where it becomes *nil*. When, therefore, the line is discharged by disconnecting the battery, and connecting the same end to the earth, as in duplex transmission, the initial portion of the discharge is the most powerful, after which it decreases rapidly until it becomes imperceptible, for the reason that the portion of the charge contained in the distant portion of the line is not only proportionately smaller in amount, but also has a greater length of line or resistance to pass through to reach the point of discharge.

In order to produce a corresponding action in the artificial line, I employ a suitable number of separate condensers, *a a*, of progressively-increasing capacity, and of which the aggregate capacity is equal to that of the line. For example, suppose the capacity of the line is represented by 1,600, and four condensers were employed, as shown in the drawing, then the capacities of the respective condensers should be approximately 700, 500, 300, and 100. Between the several condensers and the line I also place rheostats *b b*, so adjusted and arranged that the condensers will be charged and discharged through resistances having to each other the relation of the numbers 1, 2, 3, and 4. When arranged on this principle the charging and discharging of the group of condensers *a a* will correspond with that of the line with sufficient accuracy for all practical purposes. This arrangement is applicable to all descriptions of duplex and multiple telegraphs.

The line *d*, wires *e e*, and connections from 5 to 6 form the bridge, and in the bridge-wires *e* are the rheostats *f f′* and electro-magnets *g g′*, and these electro-magnets neutralize the effects of the secondary currents from the receiving-magnets placed between 5 and 6 in the bridge, which, were it not for these electro-magnets and their neutralizing discharge, would circulate in the circuit formed by *e e* 5 6, and cause the relay-magnets in such circuits to stick, or respond too slowly. The rheostats *f f′* should be adjusted to properly regulate the resistance in *e e*.

The double-coiled receiving-magnet *h h′* is worked by increased or decreased current from the distant station. I find that it is better to divide this magnet into two parts, so as to use short spools and obtain as great or greater power, with less resistance, than would arise if the whole of the wire were coiled on one core, and these magnets *h h′* are at opposite sides of the armature-lever *i* and its fulcrum, so as to act in unison.

There is a second coil or spool, k k', to each core of the electro-magnets h h' in a local circuit, with a battery, l, and adjustable rheostat, m. The action of these coils is so adjusted by the rheostat that any currents that may leak into the line from the ground by imperfect insulation or otherwise are neutralized, and for this purpose the poles of the battery are to be properly connected, according to the character of the current leaking to the line. Thereby the line is better adapted to quadruplex transmission, because if the action of the current from the distant station is varied by its strength being increased by an addition of the same polarity, or lessened by a leakage of opposite polarity, the effect is neutralized by the local circuit from l, and the coils k k' acting upon the cores of the magnets h h' in a way to balance the effect on such cores by the leakages of the line.

The armature-lever i operates the local circuit of the battery o, and in this is the sounder p, for receiving from the distant station, and to this sounder is also connected the local circuit q, as explained in one of my previous applications for patents. In this case the sounder p responds according to the pulsations from the distant station, whether the same is a rise or decrease of tension; so, also, the sounder r in the local circuit from r' is operated by the polarized magnet s, according to the reversal of the currents from the sending-station, as before explained in my previous application.

In the circuit between 5 and 6 is placed a second polarized magnet, t, and its armature is operated only by the reversal of the current, and it opens and closes the circuit from t' through the retractile magnet u. This magnet u takes the place of a spring to draw back the armature i. It is known that when a reversal of the current takes place in an electro-magnet there is a moment of neutralization or no magnetism; hence at that moment a spring, if used, pulls the armature back, and produces a false operation in the quadruplex telegraph especially. The tongue of the polarized magnet t in the circuit of the permanent retractile magnet u, being moved by reversal of current on the main line, opens the circuit of u momentarily, and then closes the same, so as to neutralize as far as possible the risk of a false movement of i by breaking the circuit of u at the instant of reversing the polarity.

The galvanometer at v and a switch, v', to place it in circuit are useful in the adjustment of the rheostats and the balancing of the electric energies. When the resistance of the artificial line is equal to that of the main line there will not be any current through the bridge; hence the galvanometer will remain uninfluenced.

The finger-keys 10 and 11 are employed to open and close local circuits to the electro-magnets 12 and 13, and these in turn operate the circuit-preserving keys 14 and 15, that are connected with the two-part battery 16, earth-wire 17, and line-wire 18, in a manner similar to that heretofore employed by me, so that one operator's message is indicated by the reversal of the polarity of the current, and the others by producing a rise and fall in the tension of the current sent.

The particular transmitting devices shown are not herein claimed, being included in my application designated as Case 99, filed September 1, 1874.

I claim as my invention—

1. In a duplex telegraph, an artificial line provided with two or more condensers of varying capacity, and a like number of rheostats of varying resistance, for regulating the charge and discharge of the same to correspond with that of the main line, substantially as and for the purpose specified.

2. The retractile magnet u, combined with the magnet h and polarized magnet t, that acts to momentarily break the circuit of u when the reversal of polarity takes place, substantially as set forth.

Signed by me this 14th day of December, A. D. 1874.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Speaking-Telephone.

No. 208,299. Patented Sept. 24, 1878.

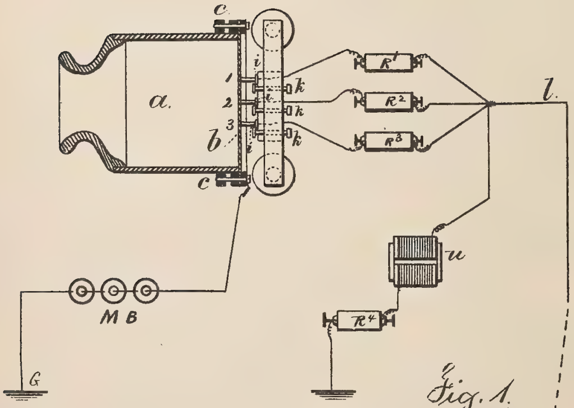


Fig. 3.

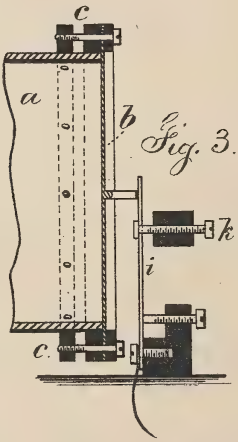


Fig. 1.

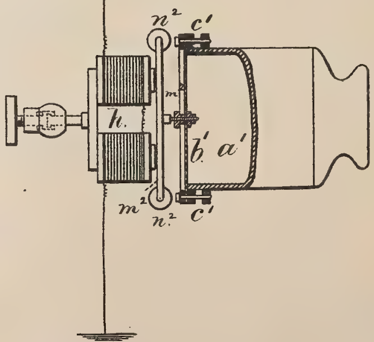
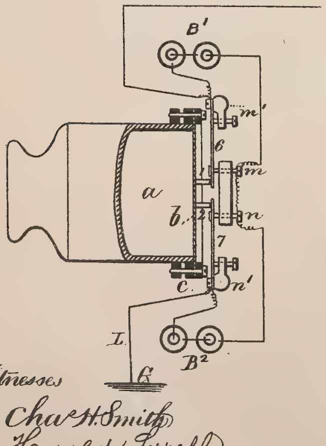


Fig. 2.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison.
per Lemuel W. Serrell
atty.

N PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEPHONES.

Specification forming part of Letters Patent No. **208,299,** dated September 24, 1878; application filed July 20, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification:

In acoustic telegraph-instruments there is comparatively little difficulty in transmitting musical tones, because the pulsations vary in number per second, and the distant reed or other receiving device that is of the same tone responds; but in speaking the tones of the voice are often in the same musical key, and hence there is difficulty in obtaining a clear response to the words spoken.

My invention relates to the transmission of varying strengths of current, according to the strength of the tone, and to a certain extent regardless of the musical key; and at the receiving-instrument a corresponding tympan receives the proper movement to produce a corresponding sound, through the agency of an electro-magnet operating on the same.

In the drawing, Figure 1 is a plan view of the transmitting and receiving devices, partially in section. Fig. 2 is a sectional view of a modification in the transmitting device; and Fig. 3 is a section, in larger size, of a portion of the transmitting apparatus.

The transmitting device consists of the resonant case *a*, with a tympan, *b*, over the end, the same being, by preference, a sheet of metal; and *c* are tightening rings and screws, whereby the tension of the tympan is regulated. A similar resonant case, *a'*, tympan *b'*, and tighteners *c'* are provided at the receiving-station, and the two should be made of the same, or nearly the same, character throughout, in order that the resonant conditions may correspond.

There are two or more contact-points at the transmitting-station. In Fig. 2, I have shown two, numbered 1 and 2; and in Fig. 1 there are three, numbered 1, 2, 3. These contact-points are so constructed and arranged in the electric circuit that when the voice acts in the resonant case and vibrates the tympan more or less, according to the strength, volume, or tone of the voice, the electrical condition of the line will be correspondingly influenced—that is to say, a feeble tone will produce but a feeble electrical response on the line, and the reverse; hence the electro-magnet *h*, acting at the receiving end, will exert a power to vibrate the tympan *b'* proportionate to the voice-power at the transmitting-station.

In Fig. 1 one pole of the main battery M B is connected to the earth, and the other to the tympan *b*. The line *l* is connected, through the rheostats R^1, R^2, and R^3, to the respective contact-springs *i*, and these press toward the points 1 2 3, respectively, but are withdrawn by the disk-pointed screws *k*, so as to be in proper proximity to the respective points. The point 2 closes the circuit, through R^2, with the smallest vibration of the tympan. The rheostat R^2 is of the greatest resistance, and hence but feeble pulsations pass to the line.

When the amplitude of vibration is increased by the strength of the sound, the circuit is closed, through R^1, by 1, and this rheostat is adjusted to offer less resistance; hence a stronger current passes to the line, and when the contact at 3 is closed the strongest current is sent on the line, because R^3 offers but little resistance. By this device the current is proportioned to the volume of sound acting upon the tympan of the resonant case, and the pulsations of that current respond to the vibrations of the tympan. Hence the electric pulsations become the reflex of the voice, and act in the distant magnet and upon the distant tympan to reproduce the same sounds. The number of contact-points and rheostats may be increased, if desired.

The electro-magnet helix *u*, rheostat R^4, and ground-connection serve to neutralize the static charge and discharge of the line and self-induction of the instruments. At the receiving-station, the armature m^2 is a spring-bar secured in standards n^2 at each end, and it is connected adjustably to the center of the diaphragm, and it vibrates by the action of the electro-magnet *h*, placed in front of it, and through the helix of this magnet the current passes from the line to the earth, or the reverse. This armature m^2 responds with greater rapidity and delicacy than a swinging armature, and

there is no risk of its movement being so great as to allow it to touch the cores of the electro-magnet and adhere to them.

In Fig. 2, the battery B^1 is connected between the adjusting-screw m and the standard m^1 of the spring 6, and the battery B^2 is in a circuit between the adjusting-screw n and the standard n^1 of the spring 7; and the screws m and n are insulated, but connected in the metallic circuit passing through the standards m^1 n^1, the batteries, and the line L to the ground G. It will now be evident that when at rest the respective batteries are short-circuited through 6 m and 7 n, and hence do not act upon the line; but when the tympan is vibrated the contact of 1 or 2 with its adjusting-screw is broken, and the battery-current passes to the line; and if the contact of both be simultaneously broken, the line-current is from both batteries and correspondingly pulsated. By this construction of circuit-closer the quantity of battery-power is increased in proportion to the increase of the power or volume of the voice in speaking.

Several of these contact-points and batteries may be used instead of two.

As I have shown in my previous application, No. 130, filed April 27, 1877, a diaphragm with means for regulating the tension thereof, no claim is herein made to such device.

In my application No. 130, filed April 27, 1877, I have shown a means for producing a rise and fall of electric tension by the vibrations of a diaphragm; and in my application No. 145, filed December 13, 1877, I have shown an armature-plate, an electro-magnet for the same, and a closed circuit to the source of undulatory electric energy. It is therefore to be distinctly understood that I do not, in this present application, make any claim to any such devices, but limit my claim hereunder to devices that are not shown in either of said applications.

I claim as my invention—

1. The combination, with the tympan arranged to respond to the human voice, of two or more contact-points operated by such tympan and the electric circuits, substantially as specified, whereby the current passing upon the line is pulsated in unison with the vibrations of the tympan and its volume proportionately increased or decreased, substantially as set forth.

2. The combination, with the resonant case and tympan, of two or more contact-points and rheostats, adjusted substantially as specified, to regulate the strength of the electric pulsations passing upon the line, as set forth.

3. The combination, with the diaphragm and resonant tube, of an electro-magnet and a spring-armature that is supported at both ends, substantially as set forth.

Signed by me this 16th day of July, A. D. 1877.

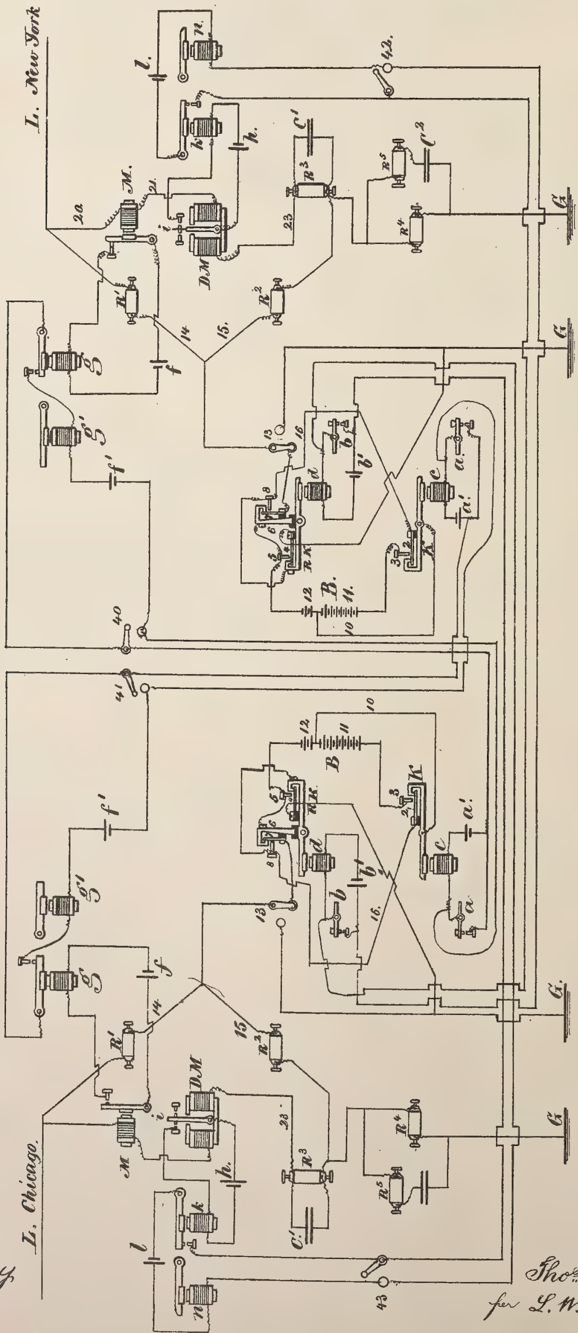
THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.
Quadruplex Telegraph Repeaters.

No. 209,241. **Patented Oct. 22, 1878.**



Witnesses,
Chas. H. Smith
Geo. T. Pinckney

Inventor
Thos. A. Edison
per L. W. Serrell
atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT.

IMPROVEMENT IN QUADRUPLEX-TELEGRAPH REPEATERS.

Specification forming part of Letters Patent No. **209,241**, dated October 22, 1878; application filed March 23, 1875.

CASE No. 113.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Quadruplex Telegraphs, of which the following is a specification:

The object of this invention is to repeat from one quadruplex circuit into another quadruplex circuit.

In my present invention I make use of two quadruplex circuits, in which the signals are made by rise and fall of tension in one relay-magnet, and by change of polarity in the other relay-magnet, which is polarized. The modes of connecting and operating have been fully set forth in applications heretofore made by me.

The present improvement relates to the connections from one quadruplex telegraph to another, whereby the circuits work into and operate each other, so that the messages are repeated automatically in one circuit by the receiving-instrument of the other circuit, instead of the finger-key being operated by hand.

The entire apparatus and connections for repeating, as aforesaid, are shown in the diagram, which, although it appears complicated, is very simple. One line, L, comes, for instance, from New York to one set of instruments at an intermediate station—say Buffalo—and the other line, L, extends to the distant instruments—say at Chicago—in the other direction.

The keys and instruments are duplicated and exactly the same, only there are two distinct sets of instruments.

Suppose that a message over the wire L from New York acts by rise and fall of tension in the relay-magnet M, and that this message is repeated into the sounder or receiving-instrument g'. If the switch 40 in the local circuit of the battery f' is closed, the message goes no farther; but if the switch 40 is open the circuit of the battery f' extends to the electro-magnet *c*, the switch of the key *a* being open. Thereby the message received at M on one line is repeated by *c* and K into the next line. So, in like manner, the message received from New York in the differential magnet D M and repeated in the sounder *n* will go no farther if the switch 42 is closed; but if the switch 42 is open the message will be repeated to Chicago at the key *b* by the magnet *d* and key R K, that reverses the circuit in the same manner as if the finger-key *b* were operated.

Of course, by opening the switch 41 the message coming over the line L from Chicago and received in M will be repeated to New York, and the same thing will occur in relation to the message received in D M from Chicago if the switch 43 is closed. Thus one or more messages may be automatically repeated in long lines without interfering with the working of the other portions of the quadruplex instruments in either direction from the intermediate station.

In an application for Letters Patent filed by me September 4, 1874, Case 99, circuit-preserving keys for changing the polarity of the current and for increasing or decreasing the electric tension, like those shown in this application, and instruments for responding to the pulsations sent by these keys are shown. I therefore do not herein lay any claim to the same.

What I claim is—

1. In combination with two main-line circuits, each capable of quadruplex operation, the repeating-magnets, local circuits, switches, and connections, arranged substantially as set forth, so that either message may be repeated independently of other messages, substantially as set forth.

2. The combination, with the receiving-sounders in one line, of repeating-instruments, local circuits and switches, and transmitting-instruments in the other line, arranged and operating substantially as and for the purposes set forth.

Signed by me this 24th day of February, A. D. 1875.

THOMAS A. EDISON.

Witnesses:

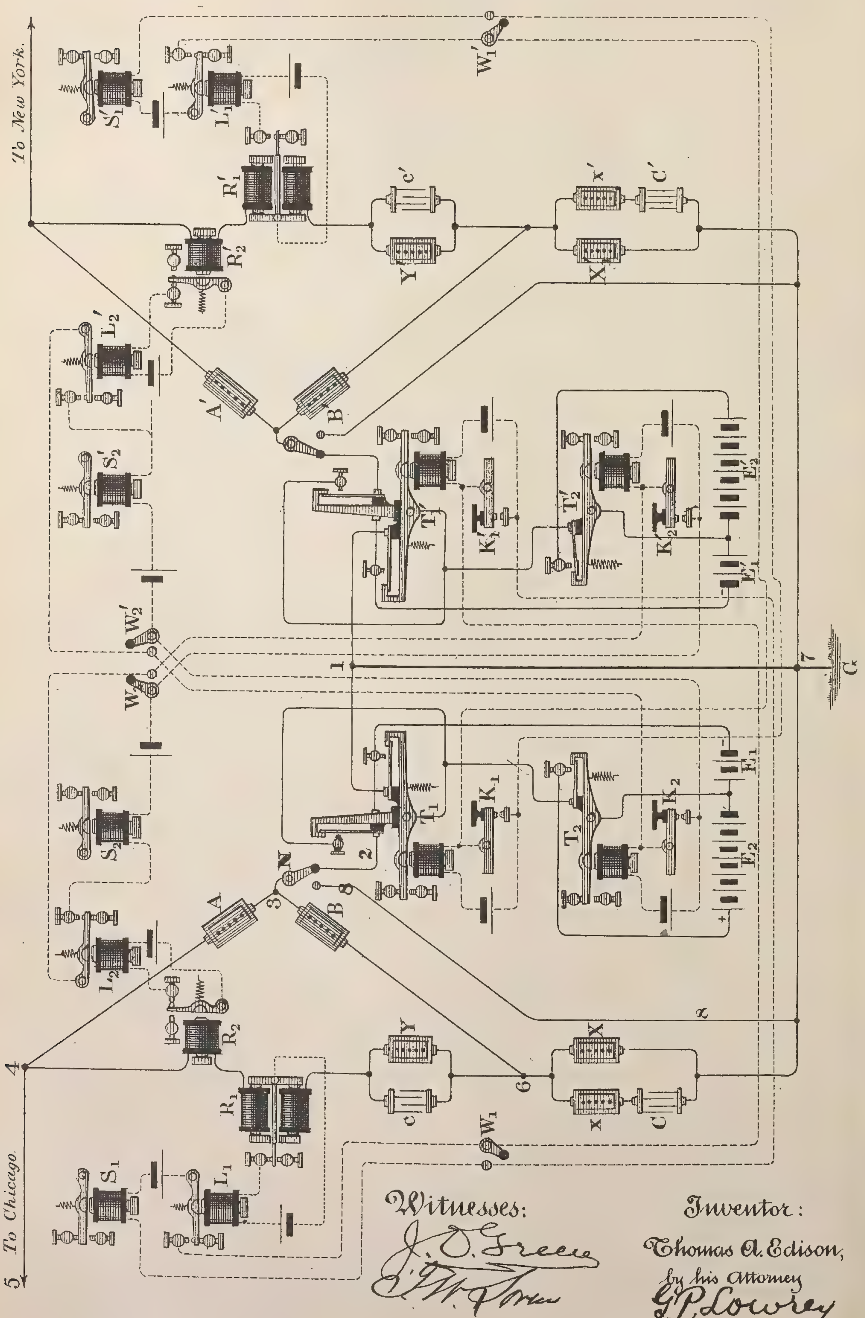
GEO. T. PINCKNEY,
GEO. D. WALKER.

T. A. EDISON,

Assignor of one-half interest to G. B. PRESCOTT.

Quadruplex-Telegraph Repeater.

No. 8,906. Reissued Sept. 23, 1879.



N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR OF ONE-HALF INTEREST TO GEORGE B. PRESCOTT.

IMPROVEMENT IN QUADRUPLEX-TELEGRAPH REPEATERS.

Specification forming part of Letters Patent No. 209,241, dated October 22, 1878; Reissue No. **8,906**, dated September 23, 1879; application filed November 16, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, now of Menlo Park, in the county of Middlesex and State of New Jersey, have invented certain new and useful Improvements in Quadruplex Telegraphs, which improvements are fully set forth in the following specification, reference being had to the accompanying drawings.

My present invention consists in certain improvements upon the apparatus described in my application for Letters Patent filed on or about the 1st day of September, A. D. 1874, for improvement in duplex telegraphs, and designated as Case 99; and has for its object, first, to provide means of compensating the effects of static induction and discharge upon the instruments at the receiving-station when two sets of signals are transmitted simultaneously in the same direction without interfering with the transmission of one or more sets of signals in the opposite direction; second, to provide means whereby the adjustment of the balance at either station, in a system of duplex or quadruplex telegraphy, may be conveniently effected without interference from the transmitting-instruments or batteries at the other station; and, third, to provide means whereby two quadruplux circuits may be coupled together, so that two sets of signals may be repeated from the first circuit into the second at the same time that two other sets of signals are being repeated from the second circuit into the first.

In the accompanying drawings I have shown two complete sets of apparatus arranged for quadruplex transmission, in order to properly illustrate the method of repeating from one set of apparatus to the other. As these two sets of apparatus are exact counterparts of each other, the same letters of reference have been applied to each, those pertaining to the right-hand set being distinguished by a prime mark.

In my hereinbefore-mentioned application designated as Case 99, I have described a duplex telegraph in which two independent sets of signals may be simultaneously transmitted over a telegraphic circuit in the same direction, one instrument at the receiving-station responding solely to changes in the polarity of the current, and the other instrument solely to changes in the strength of the current.

In my present invention the apparatus and method described in Case 99 are combined with the arrangement of circuits and method of simultaneous duplex transmission in opposite directions set forth in Letters Patent of the United States granted to Joseph B. Stearns on the 12th day of November, A. D. 1872, No. 132,932, and reissued on the 22d day of June, 1875, No. 6,508, by means of which combination I am enabled to simultaneously transmit four independent sets of signals over one wire.

When this combined apparatus, technically termed a "quadruplex telegraph," is applied to a submarine cable or a land-line of considerable length, the correct operation of the system is materially interfered with by the phenomena of static induction and discharge which manifest themselves upon the receiving-instruments. The tendency of the return discharge from the outgoing currents is to produce a false signal upon the receiving-instruments at the home station each time that the current is reversed, or the key-connection is changed from the battery to the earth. This effect is neutralized by the application of a rheostat and condenser to the artificial line in the manner fully set forth in Letters Patent of the United States No. 126,847, granted to Joseph B. Stearns on the 14th day of May, A. D. 1872, and reissued as No. 5,344 on the 1st day of April, 1873, to which reference is had.

The effect upon the receiving-instruments, when two sets of signals are being simultaneously received, of the static induction which arises from the incoming currents is entirely different and distinct from that caused by outgoing currents, and requires a different method of compensation. The manner in which I have effected this compensation will be hereinafter set forth.

Referring to the drawings, T_1 is a current-reversing or pole-changing transmitter, which is operated, in the usual manner, by a finger-key, K_1, and local battery. It is connected with the ground G at the point 1, and with the line at the point 2, and is so arranged that

when in a position of rest the positive or zinc pole of the battery E_1 is to line and the negative or copper pole to the earth; but when depressed the polarity of the battery with respect to the line and earth is reversed. T_2 is a single-current transmitter, which, when depressed, simply connects the battery E_2 to the battery E_1; and as the former is, say, three times the size or strength of the latter, the effect of depressing the transmitter T_2 is simply to increase the strength of the current going to line irrespective of its polarity.

One receiving-instrument, R_1, responds solely to changes in the polarity of the current traversing its coils without reference to its strength, while the other instrument, R_2, responds solely to changes in the strength of the current without reference to its polarity. The two sounders S_1 and S_2 are, respectively, operated by the receiving-instruments R_1 and R_2 through the intervention of the local relays L_1 and L_2.

The apparatus thus far described is essentially the same in construction and mode of operation as that described in my hereinbefore-mentioned application, No. 99; but in order to convert this into a quadruplex apparatus, it is necessary to combine it with some system of duplex transmission in opposite directions.

I have shown in the drawings the hereinbefore-mentioned method patented by Joseph B. Stearns, in which the outgoing current from the transmitter T_1 divides at the point 3 between the main line 3 4 5 and the artificial line 3 6 7. The receiving-instruments R_1 and R_2 are placed in a bridge-wire, 4 6, which is rendered neutral to outgoing currents in accordance with a well-known law by so adjusting the artificial resistances or rheostats A, B, and X that the proportion of A to B is the same as that of the line to X. The electrostatic capacity of the line is balanced by the condenser C, which is attached to the artificial line, and is therefore charged and discharged simultaneously with the main line, the duration of the discharge being regulated by means of the adjustable rheostat x. This condenser is not affected by the incoming currents, as the resistance between the point 6 and the earth at 7 is so much greater by the way of the rheostat X than by the way of 3, 2, and 1 that the position of the received current passing by that route is inconsiderable.

The effect of electro-static induction upon the alternate positive and negative signals sent by the transmitter T_1 and received by the instrument R_1 is to shorten them by increasing the length of the neutral space which separates them, and this effect increases in proportion to the square of the length of the line. The result is, that on a long line there is a tendency in the receiving-instrument R_1 to shorten dashes into dots and to obliterate dots altogether. Moreover, if a reversal occurs while a signal is being made upon the receiving-instrument R_2, the armature of the latter often falls off for so great a length of time as to make a break in the signal.

I have succeded in compensating this effect by placing a condenser, c, between the main and artificial lines, so that one set of its plates is in connection with a point in the main line, and the opposite set of plates in connection with a point in the artificial line, having the same potential with respect to outgoing currents. When the receiving-instruments are placed in a bridge-wire, as shown in the drawings, the condenser may also be attached to the bridge-wire. It is obvious that in this position it can only be charged and discharged by the action of incoming currents. When, for example, a positive current is traversing the receiving-instruments, the condenser c receives a positive charge, and at the movement of reversal gives it out again in advance of the arrival of the negative current from the distant station. This positive discharge passes through the receiving-instruments R_1 and R_2 in the reverse direction, and produces the same effect upon them as a negative current, instantaneously succeeding the termination of the positive current, thus compensating the effect of static induction upon the received signals.

The amount of charge in the condenser c is regulated, as required, by means of the rheostat Y, which is inserted in the bridge-wire between the points of connection of the condenser, the charge being always in proportion to the resistance unplugged.

In the system of quadruplex transmission which has been described there is always a current upon the line, either positive or negative, from the battery E_1, and this current, when arriving from the distant station, renders it impossible for the operator at the home station to adjust the resistances, or, as it is technically termed, "balance" the instruments. To avoid this difficulty I provide a three-point switch, N, which is placed between the point 3 at the junction of the main and artificial lines and the transmitter T_1, so that by turning the switch to connect the point 3 with the wire 8, instead of the wire 2, the line may be connected directly to the earth at G without including the battery E_1. This arrangement enables the balancing to be effected without difficulty.

In order to arrange two sets of quadruplex apparatus upon two different lines, so that each set of signals may be repeated over the other line, it is necessary to connect the receiving-instruments of each line to the corresponding transmitters of the other line, which is most conveniently done by means of the local circuits. Thus in the drawings the two sets of quadruplex apparatus are supposed to be placed at Buffalo, the left-hand line going to Chicago and the right-hand line to New York. By tracing the connections (shown in dotted lines) it will be observed that the local circuit of receiving-sounder S_1 is continuous with the local circuit of transmitter T'_1, and in like man-

ner the local circuit of sounder S_2 is continuous with the local circuit of transmitter T'_2. In precisely the same manner S'_1 and S'_2 are connected with T_1 and T_2.

By closing the switches W_1 and W_2 the local circuits connecting S_1 and T'_1 and S_2 and T'_2 may be divided, permitting each to work independently. The corresponding switches W'_1 and W'_2 on the opposite side serve a similar purpose. In this manner either one of the four separate sets of signals which are being simultaneously transmitted over one circuit may be automatically repeated into the other circuit or not, at pleasure, by opening or closing the corresponding switch.

I claim as my invention—

1. In a duplex or quadruplex telegraph, a condenser having one of its inductive surfaces connected with the main line and the other with the artificial line at points of equal potential with reference to outgoing currents, so as to receive a charge from incoming but not from outgoing currents, substantially as and for the purpose specified.

2. In a duplex or quadruplex telegraph, the combination of a main line, an artificial line, and a bridge-wire connecting the said lines at points of equal potential with reference to outgoing currents, with a rheostat or artificial resistance placed in said bridge-wire, and a condenser, the opposite inductive surfaces of which are connected with the said bridge-wire upon opposite sides of said rheostat, substantially as and for the purpose specified.

3. In a quadruplex telegraph, the combination at one station of two receiving-instruments, one operated by changes in the polarity of the current irrespective of its strength, and the other operated by changes in the strength of the current irrespective of its polarity, with two condensers, one of which receives a charge from outgoing but not from incoming currents, while the other receives a charge from incoming but not from outgoing currents, substantially as and for the purpose specified.

4. In a duplex or quadruplex telegraph, a switch or commutator placed between the transmitting apparatus and the point of junction of the main and artificial lines at the same station, and so arranged that the latter point may be disconnected from the transmitting apparatus and connected directly to the earth, substantially as and for the purpose specified.

5. In combination with two main-line circuits, each capable of quadruplex operation, the repeating-magnets, local circuits, switches, and connections, arranged substantially as set forth, so that any one set of signals may be repeated independently of any other set, substantially as set forth.

6. The combination, with the receiving-sounders in one line, of repeating-instruments, local circuits and switches, and transmitting-instruments in the other line, arranged and operating substantially as and for the purposes set forth.

THOMAS A. EDISON.

Witnesses:

STOCKTON L. GRIFFIN,
MARTIN N. FORCE.

T. A. EDISON
Vocal Engine.

No. 210,767. Patented Dec. 10, 1878.

Fig. 1.

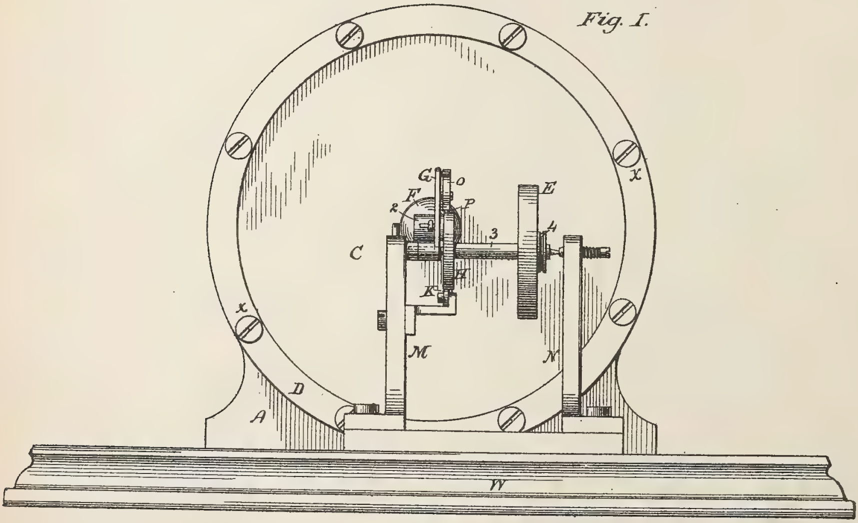


Fig. 2.

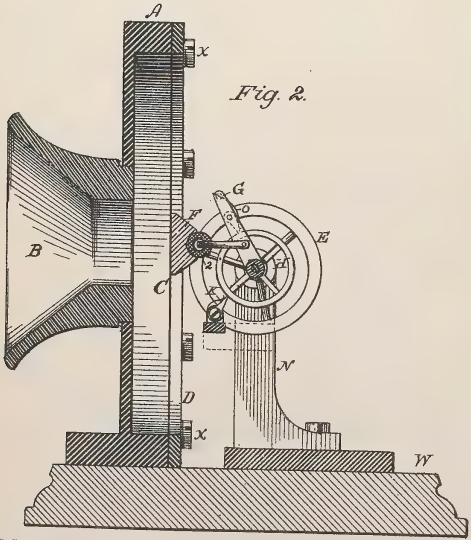
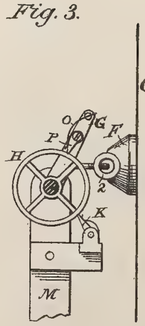


Fig. 3.



Witnesses
C. Clarence Poole
W. H. Painter.

Inventor:
Thomas A. Edison

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN VOCAL ENGINES.

Specification forming part of Letters Patent No. **210,767**, dated December 10, 1878; application filed November 27, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, Middlesex county, State of New Jersey, have invented certain new and useful Improvements in Vocal Engines; and do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

The object of my invention is to transform the vibrations of a diaphragm or other body capable of being set in vibration by sound-waves into continuous rotation of a shaft, to act as a prime motor for various light mechanisms.

My invention consists in the combination, with a diaphragm sensitive to sound-waves, of a shaft between centers having a fly-wheel attached, and combining the diaphragm therewith by a friction-clutch, which, when reciprocated by the vibration of the diaphragm, acts upon a shaft so as to continuously rotate the same when the diaphragm is actuated by sound-waves.

Figure 1 is a front view of my apparatus. Figs. 2 and 3 are side views of the same.

In Fig. 1, C is the diaphragm, of any convenient material, which is secured to the frame A by the ring D and screws X X. B is a mouth-piece for concentrating the air-waves upon the diaphragm. F is a cork secured to the center of the diaphragm. 2 is a rubber tube, into which a pin is secured. This pin connects the rubber with the reciprocating lever G, whose fulcrum is upon the shaft 3.

P is a click or pawl resting upon the wheel H, and pressed against its surface by the spring O. K is another click, secured to the upright M, which serves to prevent a backward motion of the shaft. E is a fly-wheel, for storing, by momentum, the intermittent power, and thus keeping the shaft in continuous rotation. The shaft 3 runs in centers between the uprights M and N. The whole is secured to the base W.

The action is as follows: When the mouth is placed in proximity to the mouth-piece B, and several words are spoken, or a musical note given, the sound-waves, striking the diaphragm, set it in vibration. This, in turn, reciprocates the lever G, causing the shaft to be carried forward a small distance at every vibration, and the momentum of the fly-wheel transforms these minute impulses into continuous rotation of the shaft. A small grooved pulley, 4, Fig. 1, is attached to the shaft, in the groove of which a continuous thread or band may pass to any light mechanism, and thus give motion.

I do not wish to confine myself to any particular mechanism for transforming the vibratory motion of the diaphragm into continuous motion, as a ratchet-wheel and click and many other well-known mechanical equivalents may be used. Neither do I wish to confine myself to a pulley and cord for connecting the prime mover to the apparatus to be set in motion, as a worm and wheel or toothed wheel or friction-wheel may be substituted instead.

A large cone may be inserted in the mouth-piece B, for collecting extraneous sounds and causing them to move the diaphragm.

This apparatus is useful for giving motion to clocks and other small apparatus requiring minute power.

I claim as my invention—

A vocal engine consisting of a diaphragm or other body capable of being set in motion by sound-waves, a shaft, and reciprocating mechanism, substantially as and in the manner set forth.

THOMAS A. EDISON.

Witnesses:

WM. CARMAN,

CHAS. BATCHELOR.

2 Sheets—Sheet 1.

T. A. EDISON.
Automatic-Telegraph.

No. 213,554. **Patented Mar. 25, 1879.**

Fig. 2.

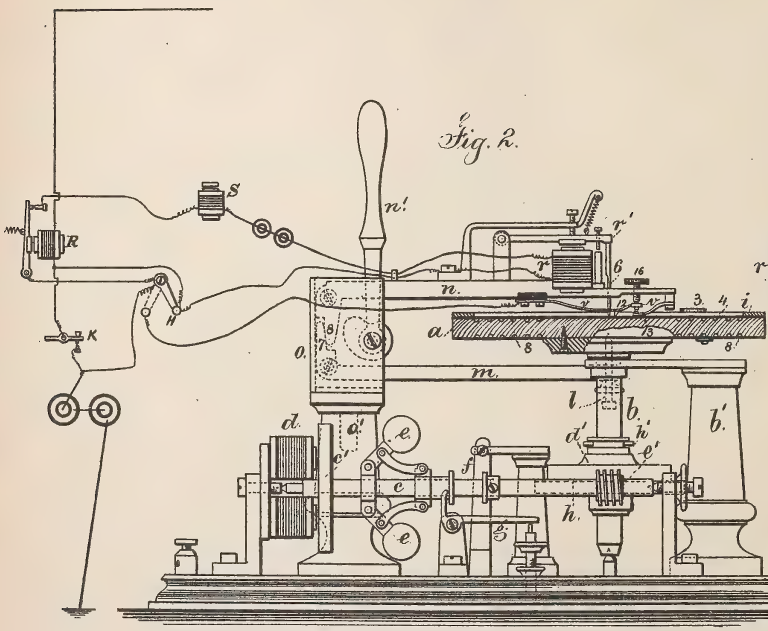


Fig. 3.

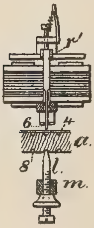
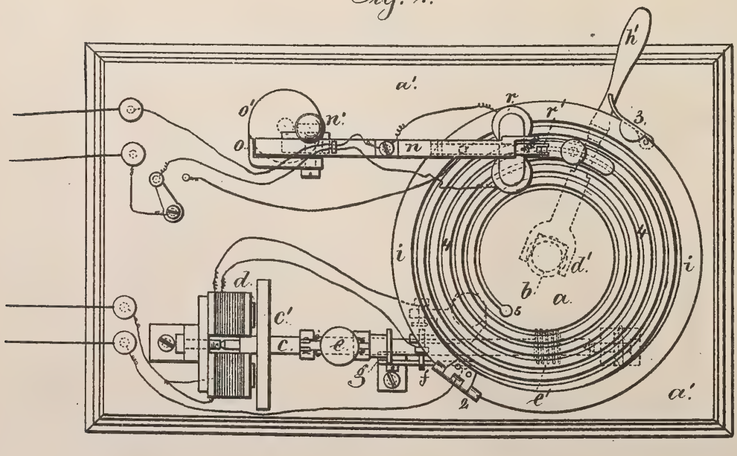


Fig. 1.



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison.
per Lemuel W. Serrell atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

2 Sheets—Sheet 2.

T. A. EDISON.

Automatic-Telegraph.

No. 213,554. **Patented Mar. 25, 1879.**

Fig. 5.

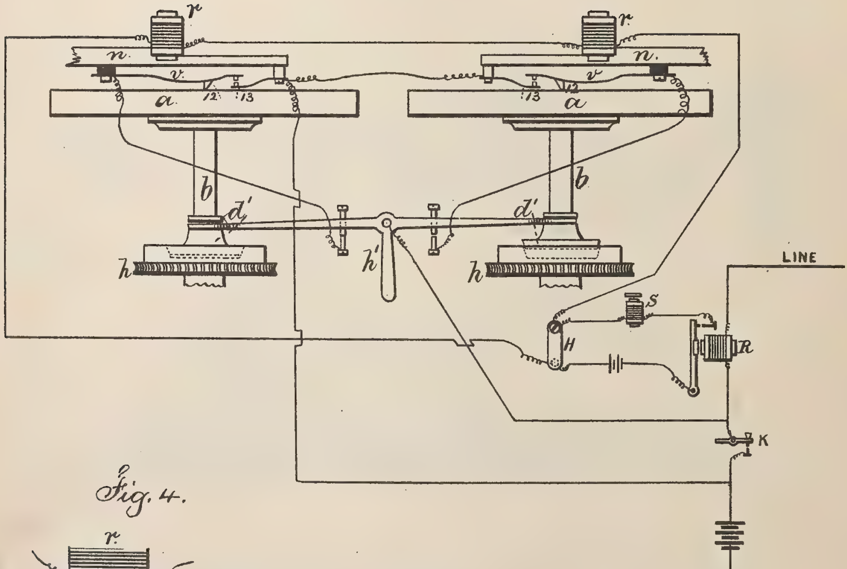


Fig. 4.

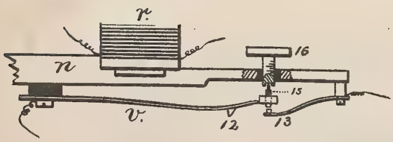
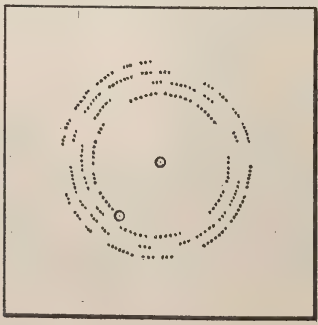


Fig. 6.



Witnesses

Chas H Smith
Geo. T. Pinckney

Inventor

Thos. A. Edison.
per Lemuel W. Serrell Atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **213,554**, dated March 25, 1879; application filed March 26, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Telegraphs, of which the following is a specification:

The object of this invention is to indent upon a sheet of paper the characters received from a distant station, or the characters transmitted from the same station, and to use such sheet of paper to transmit the same message, thus providing an automatic device for transmitting the same message more than once from one station to different stations, and for retransmitting the message automatically where it has to pass through several offices to reach its destination.

In the drawings, Figure 1 is a plan of the instrument. Fig. 2 is a side view with the indenting-plate in section; and Fig. 3 is a section of part of the indenting-plate and pin.

In chemical telegraphs a sheet of paper has been clamped to a disk, and the stylus resting upon such paper has been moved gradually toward or from the center of the disk by a volute groove in the surface of the disk itself or in a separate plate.

I make use of a volute groove in a disk or plate; but the first part of my invention relates to the disk or plate with volute groove or channel in the under surface and the guiding-point below such plate, while the point that operates upon the paper is above that plate.

The disk or plate *a* is mounted upon the vertical shaft *b*, sustained by the standard *b'* and bed *a'*. Any suitable motor is applied to revolve the shaft *b* and plate *a*.

I have shown an electric engine consisting of the shaft *c*, armature *c'*, stationary magnets *d*, governor-balls *e*, circuit-breaker or commutator *f*, and lever-arm *g*, operated upon by the governor to open or close the local circuit to the magnets *d*, according to the speed of the engine, and thereby obtain uniformity. This electric engine is similar to that shown in my Patent No. 131,343.

The worm *e'* upon the shaft *c* serves to rotate the wheel *h* upon the shaft *b*, and there is a friction-clutch, *d'*, and lever *h'*, by means of which the wheel *h* is connected with or disconnected from the shaft *b*.

Upon the plate *a* is a clamping-frame, *i*, preferably hinged at one side, 2, and provided with a swinging catch, 3, at the other side. The paper to receive the message is laid upon this plate *a*, and held by the frame *i'* around its edges.

There are to be guide-marks upon the paper and also upon the disk *a*, so that the paper can be correctly positioned upon the disk in the first instance, and replaced absolutely correct when required. For this purpose it is preferable to perforate the paper at the center and at a point corresponding to the hole 5.

The volute groove 8 is upon the bottom of the plate *a*, and in it is the point of the pin *l*, that is at the end of the arm *m*, and above the disk *a* and paper is the marking-point 6 at the end of the arm *n*.

These arms *m* and *n* are hinged to a stock, *o*, upon a vertical standard, *o'*, and there is a vertical pivot upon which the stock *o* and the lever-arms *m n* swing horizontally. The arms *m n* have right-angled toes, as seen by dotted lines at 7 and 8, and the weight of the arm *n* is greater than that of *m*, and hence the point *l* is raised up into the volute groove, and the point 6 rests upon the paper. The lever *n'* acts to raise the point 6 off the paper by pressing the lever-arm *m* downwardly when it is desired to move both points away from the paper.

The marking-point 6 is made to indent the paper by the action of the electro-magnet *r* and its armature-lever *r'*, and thereby produce Morse or other characters by pressing the paper down into the groove 4 of the disk *a*, and this electro-magnet *r* is either in the main line or (by preference) in a local circuit.

In Fig. 2 these circuit connections are illustrated. The relay-magnet R operates by its armature the local circuit to the electro-magnet *r*, and in this is placed the sounder *s*.

The operator at the receiving-station closes the switch H of his key K, and the sending operator opens his switch.

When the instrument is employed to trans-

late or repeat the message into another circuit the delicate insulated spring circuit-closer v, tracing-point 12, and contact-point 13 are made use of, and these are placed in the circuit into which the message is to be sent in order that the tracer 12 may lift the spring v and break the circuit when resting on the portion of paper that is not indented, and when the indented portion is beneath said point the spring closes the contact at 13, and the message is sent to the distant station.

The arrangement of circuits shown in Fig. 2 is convenient. In this the movement of the switch H to the dotted positions causes the main-line circuit to pass through the insulated spring circuit-closer v, point 13, arm n, so that the indented paper will give motion to the circuit-closer and transmit the message previously recorded.

The spring 13 rests upon the paper, and the circuit-closing spring v, carrying the point 12, has also the screw 15 to close the circuit upon the spring 13 when the indentation passes below the point 12. This screw 16 requires to be adjusted to suit the condition of the paper or of the indentations. I therefore provide a T-head to the screw, and a turner, 16, above it, which passes through the arm n, so that the adjustment can be made while the instrument is at work, the said turner being insulated and having a notch for the T-head of the screw, as shown in Fig. 4.

There may be two disks arranged to receive their motion from the prime mover, each having a friction-clutch that is operated by a double lever, h', whereby one disk is disconnected and stopped simultaneously, or just after the other disk is put into motion, so that when one paper is full its disk may be stopped just after the other is started, so as not to drop any signals, and the paper that is full is removed and another paper substituted. The same devices are available either in receiving or in sending messages.

In the diagram, Fig. 5, the connections for this purpose are shown, and the lever h' closes the circuit through the spring circuit-closer v and contact-point 13 in the act of shifting the power from one of the disks to the other.

It will generally be preferable to make the volute grooves in square or oblong plates, so as to receive ordinary square or oblong sheets of paper. These can be more easily filed away for future reference, and contain the dates and facts desired upon the face of the paper, in the angles thereof. Fig. 6 shows one of these square blanks. The message can be read upon these blanks, or it can be repeated at any time.

In place of having only one contact spring and point, it may be preferable to have three, placed side by side and close together, so as to allow for any inaccuracy in the position of the paper, or that may result from expansion or contraction of the paper. Either one of these points passing into the indentation in the paper will close the circuit and transmit the signal. The screw 16 allows the contact-points to be adjusted to suit the paper that is in use.

A puncturing or perforating point might take the place of the indenting or embossing point.

It is obvious that many modifications may be made to produce the same result. For instance, the electric engine may be replaced by a clock-work or other motor.

The arm n might be made to rotate instead of the plate a. The underneath spiral might be dispensed with, and the spiral on top of the plate might be continued out a greater distance from the center, and the additional spiral used for giving an outward movement to the arm. The plate itself might be dispensed with, and a drum used, with grooves cut lengthwise, and the indenting-magnet moved back and forward by suitable mechanism, the paper being fed from a continuous roll.

I am aware that it is not new to record telegraph-signals by indenting or embossing paper, as that method is adopted by Morse. Neither is it new to retransmit from such characters by causing them to give motion to contact mechanism, as that is shown in the English patent granted to William Thomson and Fleming Jenkin August 25, 1860, No. 2,047, Such embossing, however, was done on narrow strips of paper.

I claim as my invention—

1. In a telegraph in which the indented or embossed message is employed for transmitting electric pulsations, the means, substantially as specified, for recording the message in a volute line upon a sheet of paper, and for following that line with the circuit-breaking device in transmitting from such record, as set forth.

2. A plate provided with a volute groove upon its surface, and means for clamping a sheet of paper thereto, in combination with an indenting or perforating point, and means for maintaining the proper position of the point over the spiral groove, substantially as set forth.

3. A telegraphic blank of paper or similar material provided with one or more perforations, in combination with the plate receiving the same, and having corresponding marks to insure accurate adjustment in the various machines, substantially as specified.

4. The combination, with a spirally-grooved or volute plate, of an arm and indenting and transmitting mechanism supported by such arm, and a second similar groove for moving such arm, substantially as set forth.

5. In combination with a rest upon the paper, a point operated by the undulations of the surface of the paper and a circuit-closer and electric circuit to a distant receiving-instrument, substantially as set forth.

6. The arms n and m, pivoted to the stock o,

and turning upon a vertical pivot, in combination with the plate *a*, containing a volute groove, substantially as specified.

7. In combination with two revolving plates and the indenting or transmitting mechanism connected thereto, a clutch for connecting one plate before disconnecting the other, substantially as and for the purposes set forth.

8. The combination, with an indenting-instrument, electro-magnet, and spirally-grooved plate, of a sounder in the same circuit as the indenting-magnet, substantially as set forth.

Signed by me this 3d day of February, A. D. 1877.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Electric-Lights.

No. 214,636. Patented April 22, 1879.

Fig. 1.

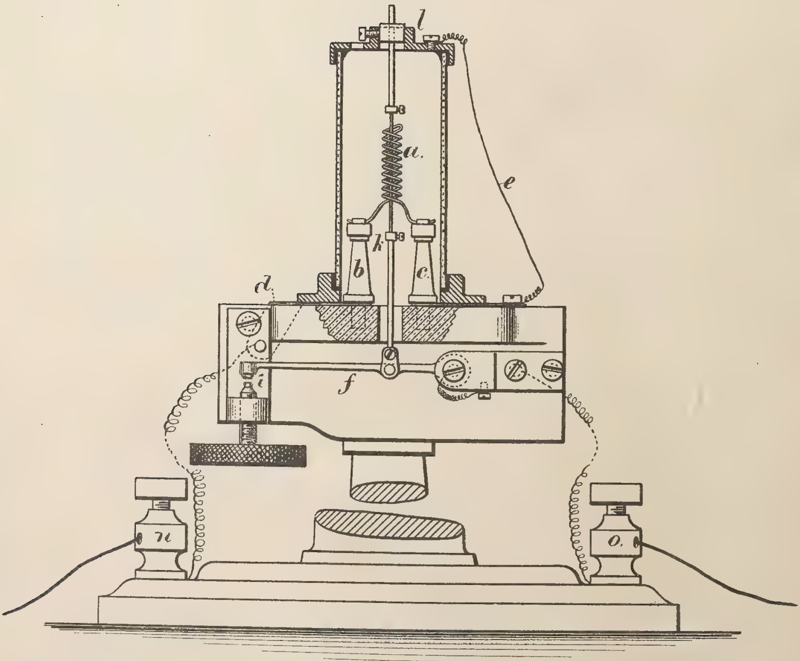
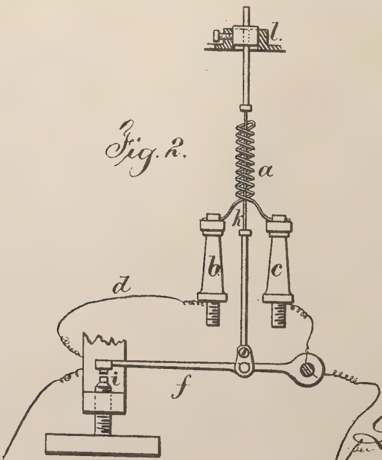


Fig. 2.



Witnesses
Chas. H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN ELECTRIC LIGHTS.

Specification forming part of Letters Patent No. **214,636**, dated April 22, 1879; application filed October 14, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Electric Lights, of which the following is a specification.

Electric lights have been produced by a coil or strip of platina or other metal that requires a high temperature to melt, the electric current rendering the same incandescent. In all such lights there is danger of the metal melting and destroying the apparatus, and breaking the continuity of the circuit.

My improvement is made for regulating the electric current passing through such incandescent conductor automatically, and preventing its temperature rising to the melting-point, thus producing a reliable electric light by rendering conducting substances incandescent by passing an electric current through them.

In my apparatus the heat evolved or developed is made to regulate the electric current, so that the heat cannot become too intense, because the current is lessened by the effect of the heat when certain temperatures are reached, thereby preventing injury to the incandescent substance, by keeping the heat at all times below the melting-point of the incandescent substance.

Various devices for carrying my improvement into practice may be employed, and I have tested a large number. I however have shown in the drawings my improvement in a convenient form, and contemplate obtaining separate patents hereafter for other and various details of construction, and I state my present invention to relate, broadly, to the combination, with an electric light produced by incandescence, of an automatic thermal regulator for the electric current.

Figure 1 represents the electric-light apparatus in the form in which the thermal regulator acts by the heating effect of the current itself, and Fig. 2 illustrates the same invention when the radiated heat from the incandescent conductor operates the thermal regulator.

The incandescent metal is to be platinum, rhodium, iridium, titanium, or any other suitable conductor having a high fusing-point, and the same is used in the form of a wire or thin plate or leaf.

I have shown the platinum wire *a* as a double spiral, the two ends terminating upon the posts *b c*, to which the conductors *d e* are connected. The double spiral *a* is free to expand or contract by the heat, as both ends are below the spiral.

A circuit-closing lever, *f*, is introduced in the electric circuit, the points of contact being at *i*, and there is a platina or similar wire, *k*, connected from the lever *f* to the head-piece or other support *l*.

The current from a magneto-electric machine, a battery, or any other source of electric energy, is connected to the binding-posts *n o*, and when contact at *i* is broken the current passes from *o* through lever *f*, wire *k*, support *l*, wire *e*, post *c*, platina coil *a*, post *b*, and wire *d*, or metallic connection, to binding-screw *n*. In this instance the wire *k*, being small, is acted upon by the electric current and heated, and by its expansion the lever *f* is allowed to close upon *i* and short-circuit the current.

The contact-point *i* is movable, and it is adjusted so that the shunt will not be closed until the temperature of the apparatus arrives at the desired height, and, by diverting a portion or the whole of the current, the temperatureof the incandescent conductor is maintained in such a manner that there will be no risk of the apparatus being injured by excessive heat or the conductor fused.

If the wire *k* is small, so as to be heated by the electricity itself, it may be placed in any convenient position relatively to the light; but if such wire is heated by radiation from the electric light, then it should be adjacent to the incandescent material.

In all instances, the expansion or contraction of a suitable material under changes of temperature forms a thermostatic current-regulator that operates automatically, to prevent injury to the apparatus and to the body heated by the current.

In Fig. 2 the current does not pass through the wire *k*, and the short-circuiting lever is operated by the radiated heat expanding the wire *k*. This in practice does not operate as rapidly as the device shown in Fig. 1.

The electric light may be surrounded by a glass tube or any other suitable device, such as two concentric glass tubes with the intervening space filled with alum-water or other bad conductor of heat, the object being to retain the heat of the incandescent metal and prevent loss by radiation, thus requiring less current to supply the loss by radiation.

I am aware that the electric current has been used to produce heat, and that such heat has been employed to vary the relative position of the light-giving electrodes and the length of the intervening arc. In my light there is no electric arc.

I claim as my invention—

1. In combination with an electric light having a continuous incandescent conductor, a thermostatic circuit-regulator, substantially as set forth.

2. In combination with an electric light, a thermostatically-operated shunt, substantially as set forth.

Signed by me this 5th day of October, A. D. 1878.

THOMAS A. EDISON.

Witnesses:

ALFRID SWANSON,
STOCKTON L. GRIFFIN.

T. A. EDISON.
Thermal-Regulator for Electric-Lights.

No. 214,637. Patented April 22, 1879.

Fig. 1.

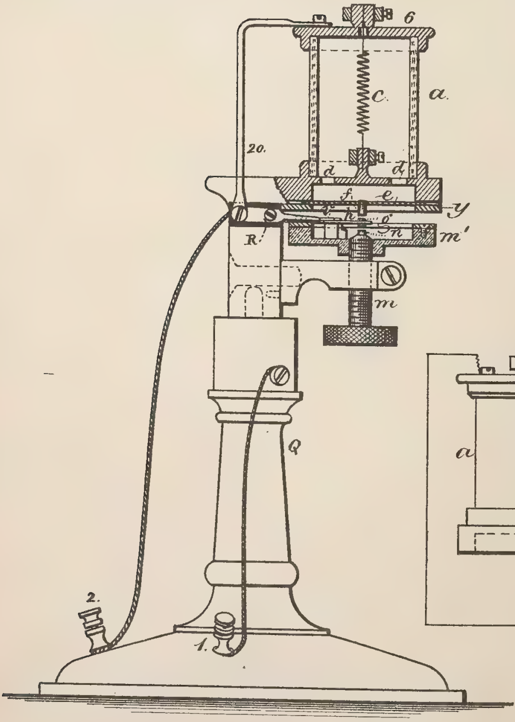


Fig. 2

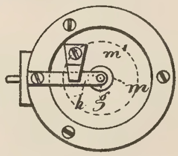


Fig. 3.

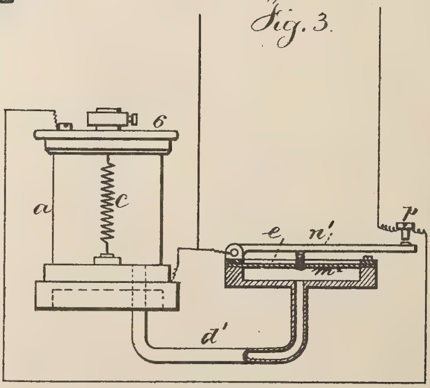


Fig. 6

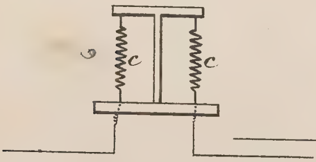


Fig. 5

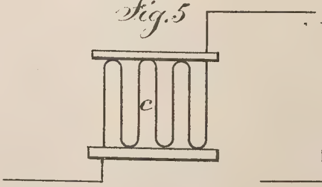
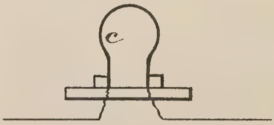


Fig. 4



Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison
per Lemuel W. Serrell
atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN THERMAL REGULATORS FOR ELECTRIC LIGHTS.

Specification forming part of Letters Patent No. **214,637**, dated April 22, 1879; application filed November 18, 1878.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Electric Lights, of which the following is a specification.

The object of this invention is to devise a reliable and economical electric lamp, to give light by incandescence due to the passage of the electric current through conductors of electricity, so that a great number of lamps may be used in one electric circuit.

The invention consists in causing the heat generated by the incandescent conductor to expand the air or fluid in the containing-chamber as its temperature rises, the pressure thus created serving to move outwardly a yielding material—such as a diaphragm—which, in its turn, serves to control the passage of the electric current through the incandescent body by means of contact-points or circuit-regulators, and thus the temperature of the incandescent conductor will be regulated automatically.

In the drawings, Figure 1 is a sectional elevation of the electric lamp, and Fig. 2 is a plan of a portion of the same. The other figures are separately referred to.

a is a glass tube or vessel, containing spiral or strip *c*, of iridium or equivalent metal, through which the current passes. *b* is the top plate, to which the spiral *c* is connected. The glass tube is secured to the metallic standard Q. *e* is a diaphragm closing the bottom of the lower chamber. There is a partition between the chamber containing the spiral *c* and the chamber of the diaphragm; but air circulates freely between the chambers through the holes *d d d d*.

When the spiral is heated by the passage of the current, the air in the chambers expands and bulges the diaphragm outwardly. On the center of the diaphragm is a platina point, *f*, immediately opposite another platina point, *g*, on a spring, *h*. This again is opposite another platina point, *n*, on the screw *m*. *m′* is a disk of insulating material, on the top of which is a brass ring in electrical connection with the spring *h*. A rubbing contact-spring, *v*, connects this ring to the insulated plate R and the binding-post 2 on the base. The frame Q is connected to the other binding-post, 1. A wire, 20, connects the spiral of the light with the plate R and binding-post 2.

When no current passes in the circuit containing this instrument, the air in the chamber is of the same pressure as the atmosphere, and the points *f* and *g* and *n* are not in contact. If, now, the current is allowed to circulate in the line, it passes, say, from binding-post 2 to R, thence through wire 20 to the top *b*, down through spiral *c* to base Q, to the other binding-post, 1.

When the spiral *c* reaches within a few degrees of its melting-point, the expansion of the air will have bulged out the diaphragm *e* and brought the points *f* and *g* together, thus short-circuiting the current from the spiral, as it now must nearly all pass from binding-post 2 to R, thence through spring *v* to the ring *y*, through spring *h* to *g*, through *f* to diaphragm *e*, to Q, and back to binding-post 1. When thus short-circuited the temperature of both the air and spiral fall by radiation, and when it reaches a certain point the diaphragm and point *f* leave *g*, and the current again passes through *c* and raises its temperature, and the same action takes place. This regulation is so rapid that the eye does not perceive any diminution in the strength of the light. The object of the contact between *g* and *n* is, that in case *f* and *g* should fail to make contact the short circuit would still take place, as *n* and *f* are both connected to Q.

It is obvious that this method may be applied in many ways. For instance, the diaphragm might give motion to a lever or spring through which the contacts might be made, and this second chamber may be separated from the one containing the spiral *c*, as shown in Fig. 3. A tube, *d′*, leads from the chamber containing the spiral to the second chamber, m^2, closed by the diaphragm *e*. *n′* is a lever, which is moved by the movement of the diaphragm, and serves to short-circuit the spiral *c* when it comes in contact with the point *p*.

Mercury may replace air in the tube *d* and chamber m^2, the pressure of the air or gas in *a* acting through such mercury on the diaphragm *e*; or the mercury may come into contact with the point *p* to make direct circuit through the mercury.

The incandescent conductors may be made

in either of the forms shown in Figs. 4, 5, or 6.

In my application No. 156, filed October 14, 1878, I have shown a thermostatic circuit-regulator in connection with the electric light. I do not therefore herein claim any feature set forth in said prior application.

I claim as my invention—

The method specified of regulating the temperature of the incandescent light-giving body, by the expansion of the air or gas in the closed vessel containing the light acting automatically in the electric circuit, substantially as set forth.

Signed by me this 14th day of November, A. D. 1878.

THOMAS A. EDISON.

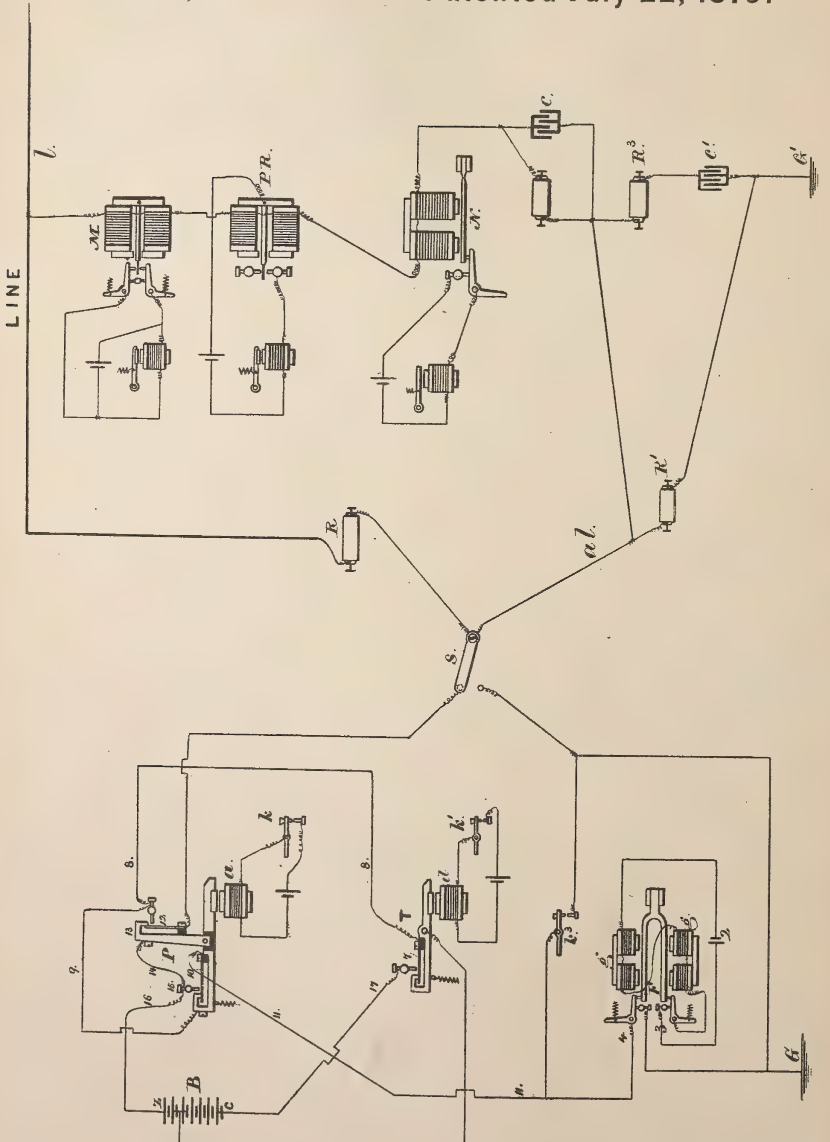
Witnesses:

STOCKTON L. GRIFFIN,

CHAS. BATCHELOR.

T. A. EDISON.
Sextuplex-Telegraph.

No. 217,781. Patented July 22, 1879.



Witnesses

Chas H. Smith
Harold Serrell

Inventor

Thomas A. Edison
for Lemuel W. Serrell
att'y

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SEXTUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **217,781**, dated July 22, 1879; application filed May 14, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Electric Telegraphs, of which the following is a specification.

This invention is an improvement upon the telegraph known as the "quadruplex," and I designate this invention as the "sextuplex telegraph."

I have discovered that the rise and fall of tension in the line and the reversals of polarity can be effected without deranging the action of one or more reeds or other instrument vibrating according to a musical tone, and reference is made to my application No. 132, in which such vibrating instrument is shown in connection with a duplex telegraph.

In my present invention I am enabled to combine an acoustic telegraph with a quadruplex telegraph, and use twelve persons to one wire, three sending from each end and three receiving at each end, there being keys to control the rise and fall of tension and the connection and disconnection of the musical pulsations with the line, and this number will be increased if there is a second or third musical transmitter and receiver introduced into the line.

In the diagram accompanying I have represented the instruments and electrical connections at one end of line, the instruments and connections at the other end of the line being similar.

The key k opens and closes a local circuit to the electro-magnet a, that operates the circuit preserving and reversing key P, and changes the polarity of the line by connecting c of the battery B to line when k is depressed, or z to line when the key is open, or the reverse, in the manner well known in connection with quadruplex telegraphs.

The key k^1 opens and closes a local to the electro-magnet d, that operates tension-key T, and connects a part or the whole of the battery B to the line to effect a rise and fall of electric tension. In both cases these operations are performed without the main-line circuits being broken.

The reed or tuning-fork F is provided with electro-magnets g, that are connected in a local circuit to the battery 2, and serve to vibrate the reed or tuning-fork, the circuit at 3 being alternately broken and closed by the movement of the reed.

At 4 the main line from ground G is pulsated by the movement of the reed or tuning-fork F and sends its pulsations on the line, and the distant tuning-fork or reed in the bridge-wire at the distant station is pulsated accordingly. If, however, the key k^3 is closed, the main line is short-circuited around the instrument F, and the main current will cease to be pulsated at 4; hence, if the key k^3 in its normal condition is closed, signals will be given at the distant reed or tuning-fork by the circuit being broken at k^3, and the reverse, for in cases where the key k^3 is open in its normal condition the signal will be given by the interruption of the musical sound at the distant station when the key k^3 is closed.

The circuits will go over the line l and the artificial line $a\ l$ preferably by the switch s, that is found to be a convenience in adjusting the receiving-instruments by connecting the line directly to the ground.

When k^1 is open, part of the battery only will be on line, the connection being from B through 6 7 8 9 10 11 to ground, (through 4 or k^3,) and returning by s 12 13 14 15 16 to z of battery.

When k^1 is closed, the whole battery B will be on line from c through 17 7 8 9 10 11, and returning as before.

When k is open, the circuit is connected through P, as before; but when k is closed the circuit is reversed at P, regardless of rise and fall of tension, the circuit being connected through T, as aforesaid, and by 8 12 to line, and returning from ground through 11, 10, 15, and 16 to z of battery.

At the transmitting-station the receiving-instruments are not influenced by the outgoing currents, because they are in the bridge-wire, the rheostats being adjusted with reference to balancing the line l and R by the artificial line R^1 to G'.

The receiving-instruments consist of the polarized relay P R, that is operated by the reversal of the polarity of the current of the magnet M, the armature of which responds to the

rise and fall of tension, and the reed or telephone N, all of which may be of any known character and respond to the respective electric conditions.

The signals may be given direct; but it is preferable to employ local circuits and sounders to each instrument.

The rheostats at R^2 R^3 serve to adjust the resistance in the bridge, and the condensers c c' serve to neutralize any static charge and discharge, the first one, c, serving this purpose in the bridge-wire and its local connections, and the condenser c' acting in the same capacity in connection with the line and ground connections.

It is to be understood that the different rheostats are to be adjusted and the resistances thereby varied according to the required conditions, as heretofore well known.

It will be obvious that the receiving-magnets may be wound with double coils, and the balance of the outgoing currents made by the differential system.

In my application No. 132, of even date herewith, I have set forth a reed operating by electro-harmonic pulsations and a relay-instrument and their appropriate transmitting-instruments; hence these are not claimed herein.

In my application No. 99 the telegraphic circuit has a key to vary the strength of current and a key to reverse the polarity, and in my application No. 125 synchronous vibrations are produced at the ends of the line by reeds or tuning-forks. These devices, therefore, are not herein claimed.

I claim as my invention—

The combination, in a telegraphic circuit, of a key to reverse the polarity of the current, a key to vary the strength of the current on the line, a vibrating reed acting to pulsate the current on the line, a key to shunt the main line and prevent the action therein of the pulsator, and three receiving-instruments in the bridge, one operated by reversal of current, the other by changes in the strength of the current, and the third by the pulsations of the current, substantially as set forth.

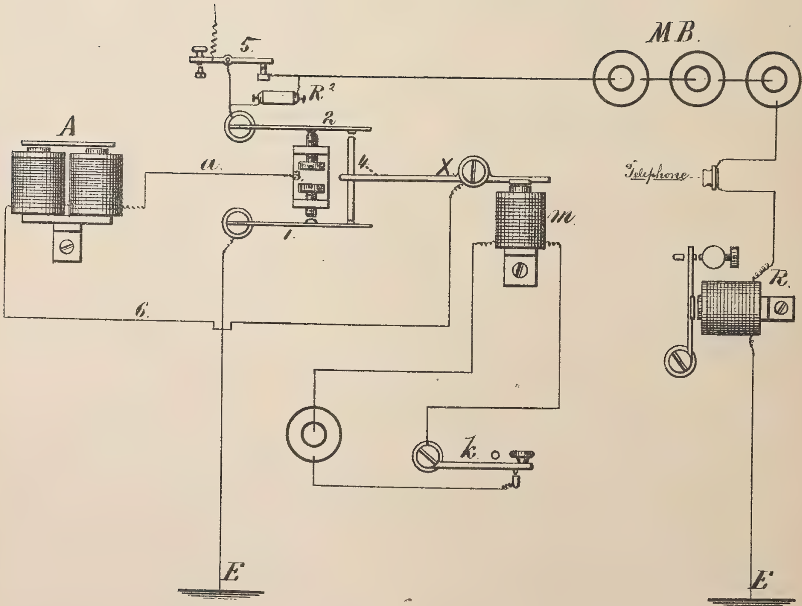
Signed by me this 8th day of May, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.
Duplex-Telegraphs.

No. 217,782. Patented July 22, 1879.



Witnesses
Harold Serrell
Chas H. Smith

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **217,782**, dated July 22, 1879; application filed November 14, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Telegraphs, of which the following is a specification.

The object of this invention is to transmit signals from one point in a circuit to other points in the same circuit without adding battery, opening the line, or varying the resistance, in order that two series of signals may be transmitted simultaneously.

The invention consists in placing an electro-magnet in circuit, and reversing its position in the line by a reversing apparatus, so that the self-induction of the magnet, which takes place at the moment of a change in the polarity of its cores, shall weaken the constant current for an instant and thus transmit the signal.

A is the electro-magnet, placed in the main line. X is a reversing-sounder. When the local circuit, in which is the magnet *m*, is opened by the key *k*, the line passes through spring 2 to 3, thence by wire *a* to the magnet A, thence by wire 6 to the lever 4, through spring 1 to the earth.

If, now, the key *k* be closed, *m* attracts the lever, and the position of the magnet A is reversed; or, in other words, a change in polarity occurs in its cores by the current of the line passing through it in the opposite direction.

The current from the line passes through spring 2 to lever 4, thence by wire 6 to A, thence by wire *a* to 3, thence through spring 1 to the earth. Although there is a constant current circulating in the line from the main battery, M B, at the moment of reversing the magnet, the powerful induction-current from A is sufficient to neutralize it for an instant. This slight opening, although scarcely affecting the relay R, becomes audible on inserting a telephone-receiver at any point in the line.

If a key, 5, be inserted in the line, and shunted with a resistance-coil, R^2, of, say, one thousand ohms, the throwing in and out of this coil by the key will cause the relay R to work, and, owing to the form of the wave, will not affect, to a perceptible degree, the telephone-receiver; hence two series of signals may be transmitted simultaneously in various directions over a single wire. Of course several stations may be placed on one circuit.

I will mention that a shunted condenser or secondary battery may replace the magnet A.

It is to be understood that the key 5 varies the tension of the line and produces a signal at the relay R, regardless of the position of the magnet A or its equivalent in the line, and that the polarity of the line is not changed by operating the key *k;* but by said key *k* a momentary change in the condition of the line is produced that is responded to in the telephone.

A condenser or secondary battery in the line acts the same as the electro-magnet A, when the flow of the current through the same is reversed by the circuit-connections without the circuit being broken.

I remark that numerous telephones may be placed in the line at various stations, and that all will respond whenever any one of the magnets in the line is reversed in its position in the line, and that these magnets A may be the ordinary relay-magnets of the Morse or other system.

By adding the key and connections one station can signal another or converse with another over the main-line wire without breaking the circuit.

I do not herein claim the combination in one circuit of telephone-instruments and the Morse instruments, as the same is set forth in my prior application No. 132.

I claim as my invention—

1. The method herein specified of producing an electric condition in the closed circuit of a telegraph-line that will give a signal in a telephone by reversing the position in that line of an electro-magnet, secondary battery, or similar device, substantially as specified.

2. The combination, in a closed circuit, of a receiving-magnet, a telephone, an electro-magnet, or its equivalent, and an apparatus for reversing the connections of the same in the circuit, a rheostat or resistance, a shunt to the same, and a key, substantially as set forth.

Signed by me this 11th day of November, A. D. 1878.

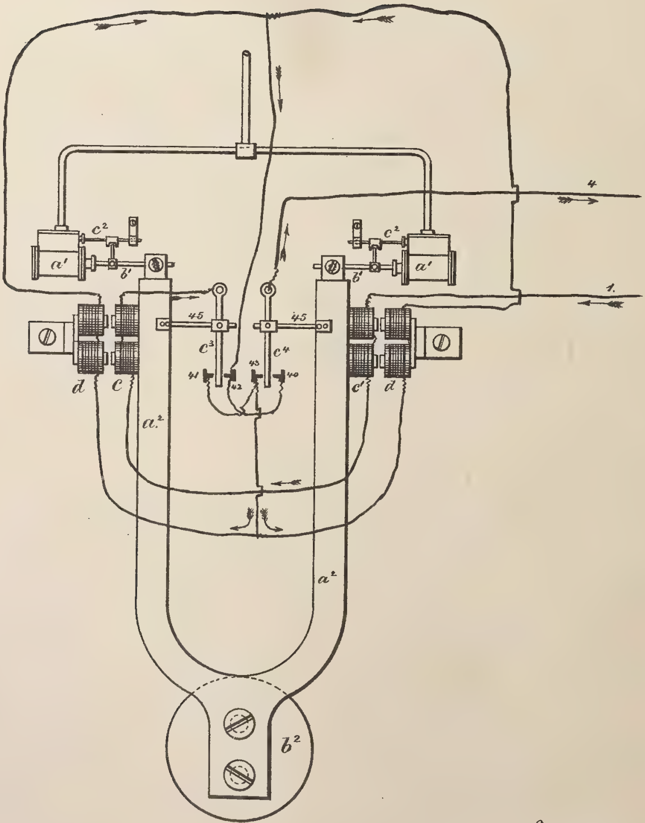
THOMAS A. EDISON.

Witnesses:

S. L. GRIFFIN,
MARTIN N. FORCE.

T. A. EDISON.
Magneto Electric Machine.

No. 218,166. Patented Aug. 5, 1879.



Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor

Thomas Alva Edison.

per Lemuel W. Serrell

att'y.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN MAGNETO-ELECTRIC MACHINES.

Specification forming part of Letters Patent No. **218,166,** dated August 5, 1879; application filed December 9, 1878.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in the Method of and Means for Developing Electric Currents, of which the following is a specification.

It has long been known that if two electro-magnets, or an electro-magnet and a permanent magnet, be drawn apart or caused to pass by each other, electric currents will be set up in the helix of the electro-magnet. It has also been known that vibrating bodies—such as a tuning-fork or a reed—can be kept in vibration by the exercise of but little power.

I avail of these two known forces, and combine them in such a manner as to obtain a powerful electric current by the expenditure of a small mechanical force.

In the drawing, a tuning-fork, a^2, is represented as firmly attached to a stand, b^2. This fork is preferably of two prongs; but only one might be employed, upon the principle of a musical reed. This vibrating bar or fork may be two meters long (more or less) and heavy in proportion. It has its regular rate of vibration, like a tuning-fork, and the mechanism that keeps it in vibration is to move in harmony. A crank and revolving shaft or other suitable mechanism may be employed; but I prefer a small air, gas, or water engine, applied to each end of the fork.

The cylinder a^1 contains a piston and a rod, b^1, that is connected to the end of the bar, and steam, gas, water, or other fluid under pressure acts within the cylinder, being admitted first to one side of the piston and then the other by a suitable valve. The valve and direct-acting rod c^2 are shown for this purpose.

The bar or fork a^2 may be a permanent magnet or an electro-magnet, or else it is provided with permanent or electro-magnets.

I have shown electro-magnet c c^1 upon the prong of the fork. There may be two or more on each, and opposed to these are the cores of the electro-magnets d; hence, as the fork is vibrated, a current is set up in the helix of each electro-magnet d in one direction as the cores approach each other, and in the other direction as they recede.

This alternate current is available for electric lights; but if it is desired to convert the current into one of continuity in the same direction a commutator is employed, operated by the vibrations of the fork to change the circuit-connections each vibration, and thereby make the pulsations continuous on the line of one polarity.

A portion of the current thus generated may pass through the helices of the electro-magnets c^1, to intensify the same to the maximum power, and the remainder of the current is employed for any desired electrical operations wherever available. I, however, use the same, especially with my electric lights.

I have represented commutator springs or levers c^3 c^4, operated by rods 45, that slide through the levers c^3 c^4, and by friction move them. When the prongs a^2 a^2 are moving from each other the contact of levers c^3 c^4 will be with the screws 40 41, and the current will be from line 1 through c^1 to c; thence to c^3, to 41 43, and to circuit of electro-magnets d d, and from d d, by 42, to 40 c^4 and line 4, as indicated by the arrows. When the prongs a^2 a^2 are vibrating toward each other, the circuit will be through c^1 c c^3 42, in the reverse direction through the circuit and magnets d d, back to 43, and by c^4 to line 4.

I claim as my invention—

The combination, with a vibrating body similar to a tuning-fork, of mechanism for maintaining the vibration, and magnets, cores, and helices, whereby a secondary current is set up, so as to convert mechanical motion into electric force, or the reverse, substantially as set forth.

Signed by me this 3d day of December, A. D. 1878.

THOMAS A. EDISON.

Witnesses:
STOCKTON L. GRIFFIN,
GEO. E. CARMAN.

T. A. EDISON.
Apparatus for Electric Lights.

No. 218,167. Patented Aug. 5, 1879.

Fig. 1.

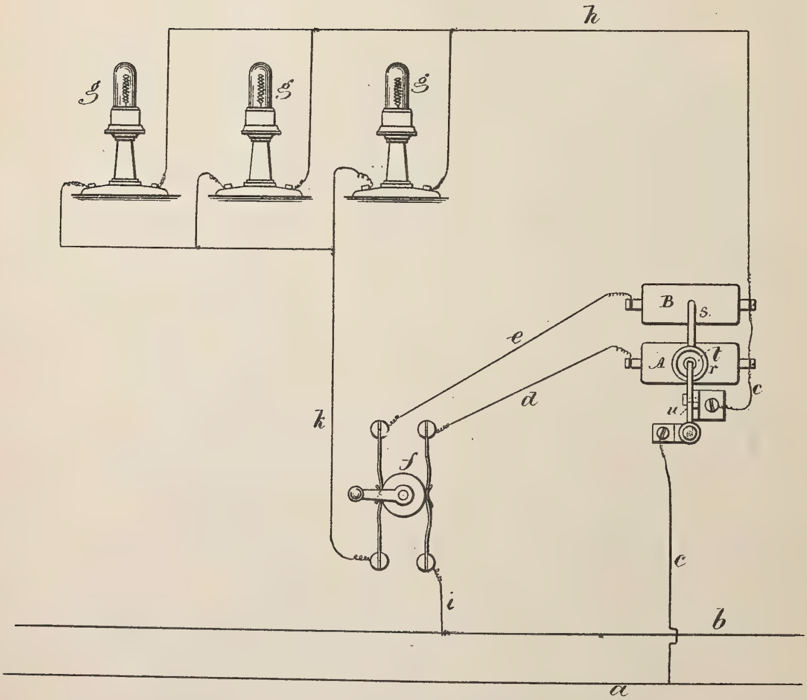


Fig. 3.

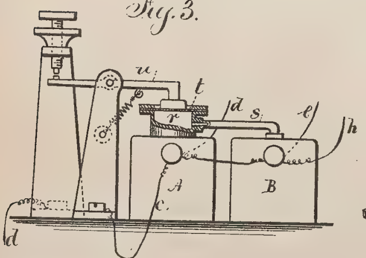
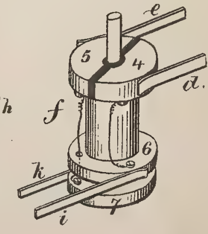


Fig. 2.



Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison

per Lemuel W. Serrell
atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN APPARATUS FOR ELECTRIC LIGHTS.

Specification forming part of Letters Patent No. **218,167**, dated August 5, 1879; application filed January 10, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Apparatus for Electric Lights, of which the following is a specification.

It is well known that an electric current passed through a secondary battery is stored up or reacts after the original current ceases, so that it can be used as a source of electricity.

I employ two secondary batteries, such as those known as the "Plante batteries." One of these is connected in the main circuit, and the same becomes charged. A circuit-changer is introduced in the circuits in such a manner as to connect this charged battery with one or more electric lights, and simultaneously throw the main circuit through the other secondary battery, to charge the same, after which that is connected with the electric lights, and the main circuit reconnected to the first secondary battery, and so on.

In the annexed diagram, Figure 1, the circuit-connections are illustrated, and Fig. 2 is a perspective view of the switch. Fig. 3 is a side view of the secondary batteries.

The secondary batteries A B are of any desired construction. I prefer, and use, two sheets of lead wound together into a square or cylindrical form, and immersed in acidulated water in a closed case.

The main line *a* is connected with any magneto-electric machine or other source of electric energy, and *b* is the return-line or earth-connection.

The main line *a* is connected by the wires *c* to the secondary batteries A B, and the return-wires *d e* pass through the switch *f* and wire *i* to *b*.

The electric lamps *g* are represented in branch circuits between the wires *h* and *k*. The wire *h* connects to one of the secondary batteries A B, and the wire *k* connects to the switch *f*.

The switch *f* is preferably cylindrical, with two insulated half-cylinders, 4 and 5, against which the springs of *c d* rest; and from these half-cylinders are metallic connections to the insulated disks 6 and 7, respectively, against the peripheries of which the springs of *i k* rest, and this switch can be rotated periodically by a handle or by a clock-work or other suitable means.

When the switch *f* is in one position the main circuit is closed through *a*, *c*, A, *d*, 4, 6, and *i* to *b*, and the secondary circuit is closed from B through *h*, lamps *g*, wire *k*, switch 7 5, and wire *e* to B.

When the switch *f* is in the other position the main circuit from *a* passes by *c* to B, and by *e*, 4, 6, and *i* to *b*, while the secondary circuit from A is by *h* through lamps *g*, wire *k* 7 5, and wire *d* to A, so that when the secondary battery B is furnishing the accumulated electricity to the lamps *g* the main current is charging the secondary battery A, and vice versa.

The switch *f* may be actuated periodically by clock-work or any suitable mechanism.

When a secondary battery is fully charged, the decomposition of the liquid commences and gases are developed. I avail of this to actuate a circuit-regulator and disconnect the main current.

The two closed cases in which the secondary batteries are placed are provided with tubes *s*, passing to a chamber, *r*, beneath a flexible diaphragm, *t;* and in the metallic circuit *c* there is a switch or lever, *u*, that is acted upon to break the electric circuit to the secondary batteries when the gases have accumulated sufficient pressure to move said diaphragm.

The accumulated gases combine, and in so doing maintain the electric action of the secondary batteries, and the pressure decreases, and the circuit is again closed by the lever *u*.

I am aware that gas has been produced by an electric current decomposing a liquid, and that the confined gas has been employed to move electrodes and regulate the main current.

I claim as my invention—

1. The combination, with electric lamps and a main circuit, of two secondary batteries and circuit-connections and switch, substantially as set forth, to alternately change the

main and secondary circuits, substantially as specified.

2. The secondary circuit, containing electric lamps, and the secondary battery and inclosing-case, in combination with the main circuit through the secondary battery, a diaphragm acted upon by the accumulation of gas in the secondary battery, and a switch-lever in the main circuit, substantially as and for the purpose specified.

Signed by me this 31st day of December, A. D. 1878.

THOMAS A. EDISON.

Witnesses:

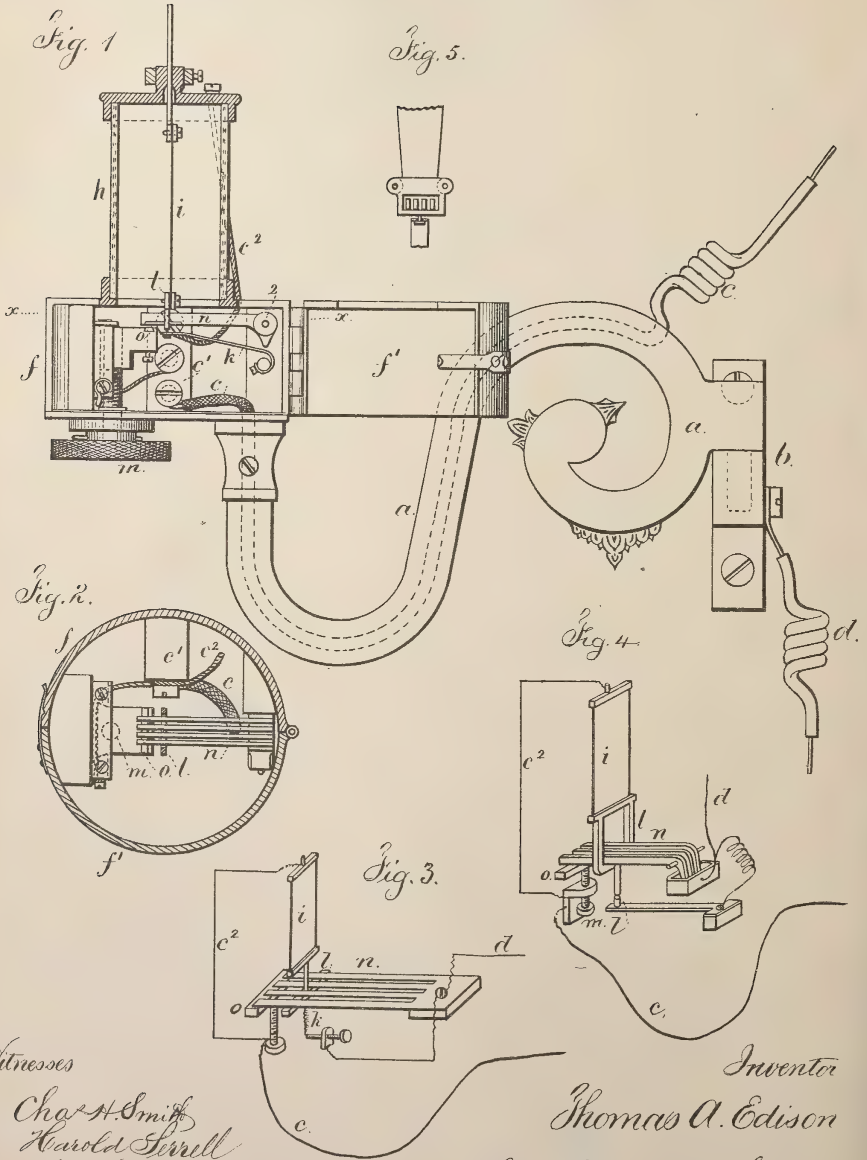
WM. CARMAN,

BENJ. D. ACKER.

T. A. EDISON.

Electric Lighting Apparatus.

No. 218,866. Patented Aug. 26, 1879.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison

per Lemuel W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN ELECTRIC LIGHTING APPARATUS.

Specification forming part of Letters Patent No. **218,866**, dated August 26, 1879; application filed December 9, 1878.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in State of New Jersey, have invented an Improvement in Electric Lighting Apparatus, of which the following is a specification.

In an application before filed by me, the light-giving body is combined with the circuit-connections and a thermal regulator that prevents injury to the apparatus by short-circuiting the current or placing a resistance therein. I do not therefore herein claim any such device.

My present invention relates to the combination, with the light-giving body, of a range of levers and contact-surfaces arranged in such a manner that the current is short-circuited or shunted to a greater or less extent, according to the heat of the incandescent light-giving body.

In the drawings, Figure 1 is an elevation of the bracket and a section of the light-giving apparatus. Fig. 2 is a sectional plan at the line *x x*. Figs. 3 and 4 are diagrams of the circuit-connections; and Fig. 5 is a partial elevation endwise of the shunting-levers.

The bracket *a* is sustained by a socket and pin at *b*, so that it may be swung like a gas-fixture.

c is one of the electric conductors. The same is insulated and passes into an opening in the bracket, and thence to the electric light, and the return circuit is through the pipe *a* to the wire *d*, or to the gas-pipe, if the bracket is upon a gas-pipe.

The conductor *c* passes to the insulated plate c^1 within the case *f*, and, for convenience, this case *f* has a swinging door, *f'*. in one side to give access to the interior parts. Above the case *f* is a glass cylinder, *h*, or other suitable protection for the electric light, and *i* is a strip of platina-foil or other known or desired light-giving material that can be rendered incandescent and produce the necessary light without melting. The conductor c^2 passes to one end of this light, and the other end of *i* is connected by the spring *k* with the metal part of the bracket, and thence to *d*.

The spring *k* serves to keep a slight tension on the foil *i*, and the yoke or frame *l* intervenes between the spring *k* and the foil.

There are levers *n*, or springs, that are connected at 2, and their free ends rest in and upon the yoke or frame *l*, and their ends should be tipped with platina.

The bar *o* is preferably of platina, and it is adjustable by means of the screw *m*, that raises or lowers the same, so as to bring it nearer to or farther from the ends of the levers or springs *n*. This adjustment is made so that the ends of the springs or levers *n* will not be in contact with the bar *o* while the light is in its normal condition; but when the heat of the foil *i* becomes excessive the expansion allows the ends of the springs or levers *n* to come into contact with the bar *o* and set up a shunt or short circuit from *c o*, through *n*, to *d*, and, according to the amount of expansion in *i*, so one, two, or more of the bars or springs *n* will be in contact with *o*, because said bar *o* is farther from the levers *n* at one end than at the other. By this means injury to the light-giving body is prevented, and a path established for the electric current becomes less in resistance as the points of contact between *n* and *o* increase in number.

The lower end of the yoke *l* may come into contact with the spring or stud *t* at the extreme expansive movement, as seen in Fig. 4, to still further lessen the resistance between *c* and *d* and divert the current from the foil *i*.

The ends of the levers *n* may be in a bath of mercury, as seen in Fig. 4, to insure electric contact. If the foil *i* is accidentally broken or injured the circuit through *n* is instantly closed, so that other lights in the same circuit are not extinguished. This device is automatic, so as to avoid the extinguishment of other lights.

I claim as my invention—

1. The combination, with the light-giving body, of two or more circuit levers or springs, *n*, a yoke, *l*, a contact-bar, *o*, and the circuit-connections, substantially as set forth, for lessening the resistance of the shunt as the temperature of the light-giving body increases, as specified.

2. The circuit-connection *t*, in combination with the levers or springs *n*, yoke *l*, light-giving body *i*, and circuit-connections, substantially as set forth.

Signed by me this 3d day of December, A.D. 1878.

THOMAS A. EDISON.

Witnesses:
STOCKTON L. GRIFFIN,
GEO. E. CARMAN.

T. A. EDISON.

Dynamo-Electric Machine.

No. 219,393. Patented Sept. 9, 1879.

Fig. 3.

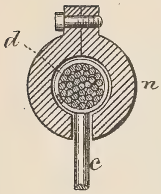
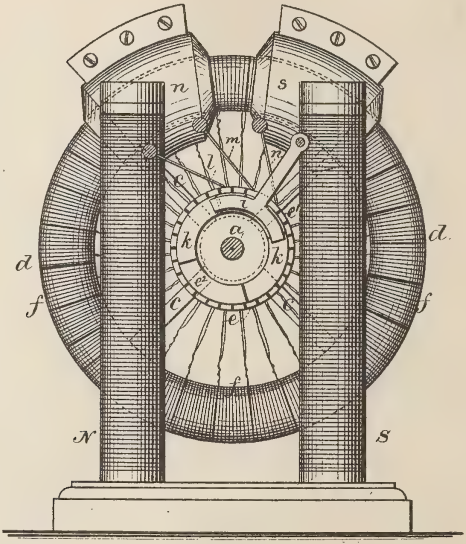
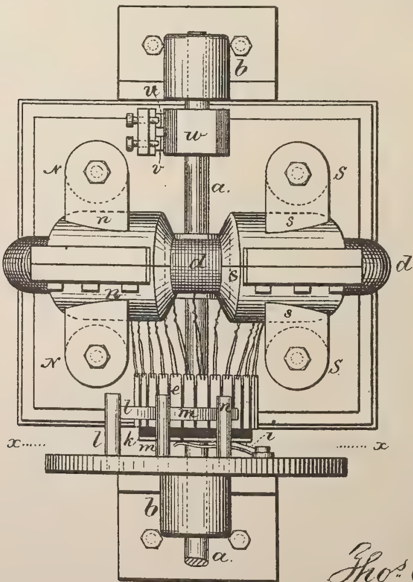


Fig. 2.



Case No. 180.

Fig. 1.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thos A. Edison

per Lemuel W. Serrell atty

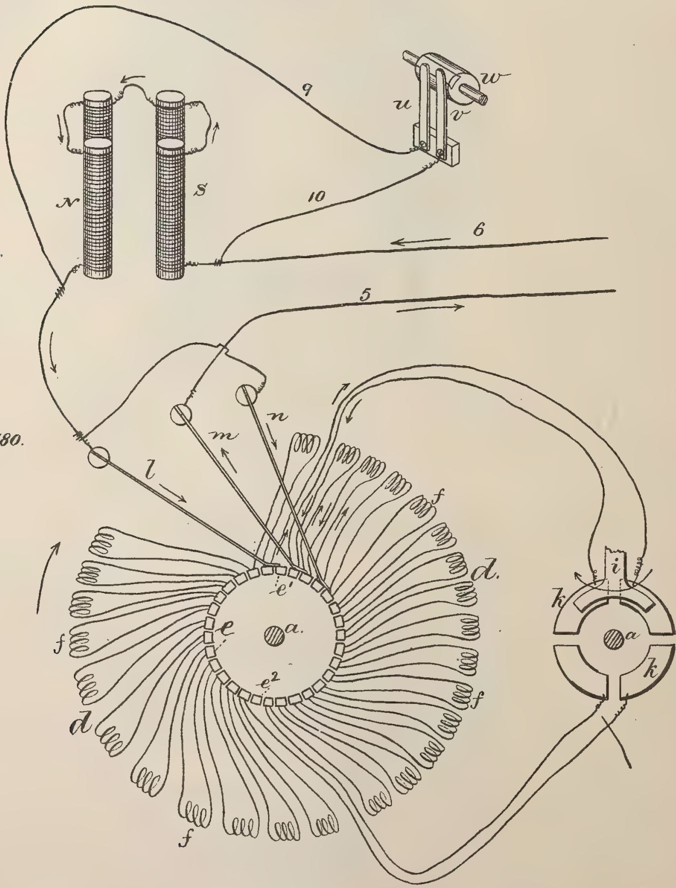
N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

2 Sheets—Sheet 2.

T. A. EDISON.
Dynamo-Electric Machine.

No. 219,393. Patented Sept. 9, 1879.

Fig. 4.



Case no. 180.

Witnesses

Chas H. Smith
Harold Serrell

Inventor

Thos A. Edison

per Lemuel W. Serrell atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN DYNAMO-ELECTRIC MACHINES.

Specification forming part of Letters Patent No. **219,393**, dated September 9, 1879; application filed July 10, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Dynamo-Electric Machines, of which the following is a specification.

I make use of a ring supported by arms and revolved between the cores of a field-of-force magnet. There are helices around this ring connected to commutator-plates, and the current is taken off by three springs, two of which are connected together and receive the current of one polarity, and the other spring receives the current of the opposite polarity. The helices of the ring, as they are revolved through the magnetic field of the field-of-force magnets, have the secondary current set up in them, and the same is taken off by the commutators aforesaid.

To insure the entire current passing off by the commutators, and to prevent the secondary current circulating in the helices of the revolving ring, the continuity of the helics or helical sections is interrupted at two or more places; and to avoid the interruption of the line-current, I use a stationary bridge and revolving contact-blocks to close the circuit at the interruption of the helix-wire, when the same is in the line-circuit, through the commutators.

I have discovered that an increased magnetic effect is produced in the field-of-force magnets by periodically shunting the current, as will be more fully described hereinafter.

In the drawings, Figure 1 is a plan of the machine. Fig. 2 is an elevation with the frame removed at the line *x x*. Fig. 3 is a section through the ring and the core-extension of the field-of-force magnet, and Fig. 4 is a diagram of the connections.

The shaft *a* is supported in suitable bearings *b* and revolved by power. Upon this shaft are arms *c*, that sustain the ring *d*. This ring may be of one piece of iron; but I prefer to use fine wire wound into a coil or ring, and having a circular form sectionally, as seen in Fig. 3.

Around the ring *d* there are helices wound in numerous sections, *f*, and the wires are taken off to commutator-plates *e*, as illustrated in the diagram, Fig. 4. One end of one helix-wire is joined to the same commutator-plate *e* as one end of the next helix-wire, except at two or more places around the ring, where there is a break in the metallic connections of the helices. I have shown two such breaks at the blank commutator-bars e^1 e^2, where the wires, instead of passing from the helical sections to such plates e^1 e^2, pass to the secondary commutator-blocks *k*, composed of four insulated blocks, and *i* is a stationary bridge of metal, against which the blocks *k* revolve. These blocks *k* are upon a cylinder of insulated material on the shaft *a*, and revolve with it. The operation will be hereinafter explained.

The field-of-force magnets N S are wound with helices, and there are lateral projecting cores *n s*, with openings through them, in which the ring *d* is revolved, said lateral cores being close to the helices of the rings, but not touching the same, as seen in Fig. 3, so that the helices pass across the magnetic field somewhat the same as in the Paccincti or Gramme machines.

The commutator-springs *l m n* bear upon the commutator-plates, and the circulation of the electric current will be from the springs *l* and *n*, through the helices that are in the field of magnetic influence, and thence by the spring *m*, or the reverse, according to the polarity of the field-magnets and the direction of revolution, the same polarity of secondary current being set up in the helix-section that is approaching N, that is set in another helix that is moving away from S; hence the springs *l* and *n* are connected to one line-wire, and the opposite polarity of current is set up through *m*, as indicated by the arrows, Fig. 4, said spring *m* connecting to the neutral point between the poles of the field-magnets.

From the foregoing it will be understood that a continuous current is set up in *l m n* from those helix-sections that are passing through the magnetic field. The commutator-springs, however, have to bear upon two of the commutator-plates at the same time to avoid interruption in the current or a spark.

The current passes from *m* out upon the line-wire 5, and returns upon the line-wire 6 to *l n*, or the reverse, and the helices of the field-of-force magnets N S are in this circuit, as shown in Fig. 4.

The secondary commutator-blocks *k*, being insulated, form two breaks in the helix-sec-

tions; but the stationary bridge i is in such a position that the circuit is maintained in the helices that are in the magnetic field, such bridge answering the same purpose as it would to connect the helix-wires continuously to the commutator-plates e^1 e^2. The metallic circuit, however, is broken on the opposite side at the commutator e^2, so that currents cannot circulate through the ring of helices.

As the connections are illustrated, it will be seen that the current is always free to circulate through the helices of the field-of-force magnets, and under ordinary circumstances the electric effect will be augmented until the maximum effect is attained. I have discovered that by combining with the field-of-force magnet and the circuit through the same a shunt open and closed periodically, the dynamic effect is greatly increased.

9 and 10 are shunt-wires from the line-circuit at each side of the helices of the field-magnets, and u v are springs bearing upon a cylinder, w, that is upon the shaft a, and is revolved with it. Part of the surface of w is of conducting and part of insulating material. When the springs u v rest upon the conductor the current is shunted or short-circuited, and, finding a route of less resistance, does not pass through the helices of the field-of-force magnets, and acquires thereby increased volume, as the resistance is less; but so soon as the non-conducting material comes into contact with u and v, the shunt is broken, and the increased current, having no other route, is obliged to pass through the helices of the field-magnets, and augments the magnetism and increases the current, so that the energy of the machine is promoted by shunting the field-of-force magnets; and this I do every revolution of the shaft a, but it may be done more or less frequently.

By the arrangement shown the helices of the ring are not liable to become heated, because the current passes through but a small portion of the ring, and the other parts of the ring are open to atmospheric influence and free to cool.

I claim as my invention—

1. In a magneto-electric machine, a ring of helical sections connected to commutator-plates, and the metallic circuit, interrupted at two or more places, in combination with the field-of-force magnet, the springs l n, connected together and to one wire of the circuit, and the intermediate spring, m, to the other wire of the circuit, substantially as set forth.

2. The combination, in a magneto-electric machine, of a field-of-force magnet, revolving helix-sections, commutator-plates, to which the helix-sections are connected, the springs l m n, the secondary commutator-blocks k, and a metallic bridge, i, to the same, for maintaining metallic connection in the helices that are within the field-magnets, substantially as set forth.

3. In a dynamo-electric machine, a shunt around the helices of the field-of-force magnets, and means for opening and closing that shunt periodically, for the purposes and substantially as set forth.

Signed by me this 7th day of July, A. D. 1879.

THOS. A. EDISON.

Witnesses:

S. L. GRIFFIN,

FRANCIS R. UPTON.

T. A. EDISON.
Electric-Light.

No. 219,628.   Patented Sept. 16, 1879.

Fig. 1.

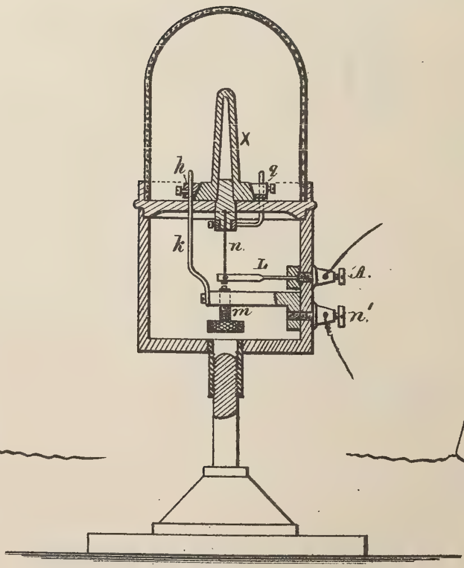


Fig. 2.

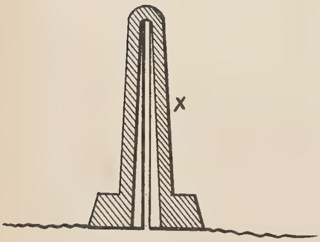


Fig. 3.

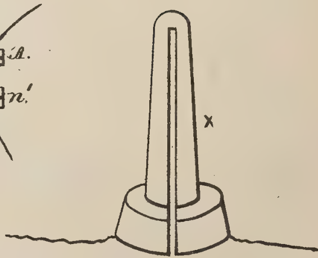
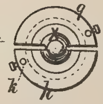


Fig. 4



Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison.

per Lemuel W. Serrell
att'y

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN ELECTRIC LIGHTS.

Specification forming part of Letters Patent No. **219,628**, dated September 16, 1879; application filed December 9, 1878.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Electric Lights, and the following is declared to be a description of the same.

The object of this invention is to produce a candle or light-giving body by the incandescence of a conductor of electricity in the form of a cylinder, prism, or other mass of a size adapted to yield the required volume of light.

The invention consists in an electric-light-giving body formed of a conductor, such as finely-divided platinum, iridium, ruthinium, or other metal difficult of fusion, incorporated with non-conducting material.

The candle, made as aforesaid, can be of any desired size or shape, and the metallic particles become incandescent by the passage of the current, and the non-metallic materials are luminous and increase the brilliancy. This is accomplished by a comparatively small electric current. I mix with such finely-divided conductors infusible materials—such as oxide of magnesium or zirconium—in different proportions, so as to obtain any degrees of conductivity required.

In some instances I saturate rods, sheets, or other forms of infusible oxides with a salt of the metal difficult of fusion, and reduce the same by heat to a metallic state.

I will mention that the use of a non-conducting material is not absolutely necessary, as the finely-divided metals, owing to their porosity, have high resistance, and become easily incandescent; but I prefer to use the non-conductor.

In Figure 1 is shown a lamp composed of finely-divided iridium mixed with oxide of zerconium and molded in the form of a split hollow cylinder, x. Fig. 2 is a detached section of the same. Fig. 3 is a perspective view, and Fig. 4 is a plan view.

The cylinder being split, the current enters the binding-post A, passes through the lever L, through the regulating-wire n to the plate g, thence up one side of the iridium cylinder x, down the other side to the plate h, thence, by wire k, to the regulating-screw m and binding-post n'.

The regulation of the temperature of the cylinder x is obtained by the thermal-current regulator in the same manner as is shown in my application No. 156, filed October 14, 1878.

The incandescent conductor made in this manner may be of any desired shape.

I claim as my invention—

1. For electric lighting, a conductor of electricity formed of finely-divided metal incorporated with a non-conductor of electricity, substantially as set forth.

2. A rigid electric-light-giving body having a longitudinal incision or separation from the base to near the end, for insuring the circulation of the electric current through the entire body, substantially as set forth.

3. In combination with a rigid light-giving body having a longitudinal incision, an expansive thermal-circuit regulator to control the strength of the current by the heat developed, substantially as set forth.

Signed by me this 3d day of December, A. D. 1878.

THOMAS A. EDISON.

Witnesses:

STOCKTON L. GRIFFIN,
GEO. E. CARMAN.

2 Sheets—Sheet 1.

T. A. EDISON.
Telephone.

No. 221,957. Patented Nov. 25, 1879.

Fig. 1.

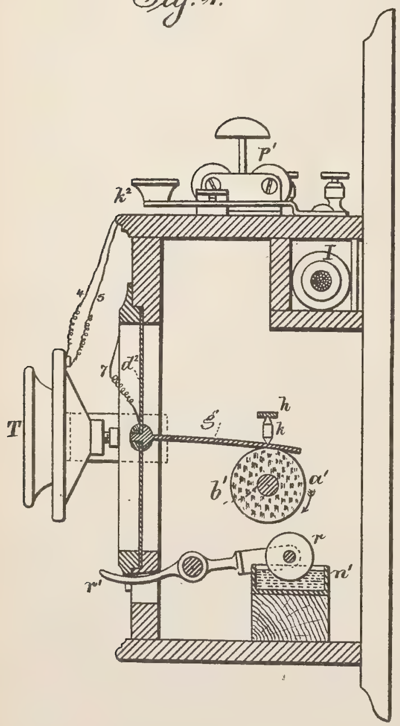


Fig. 2.

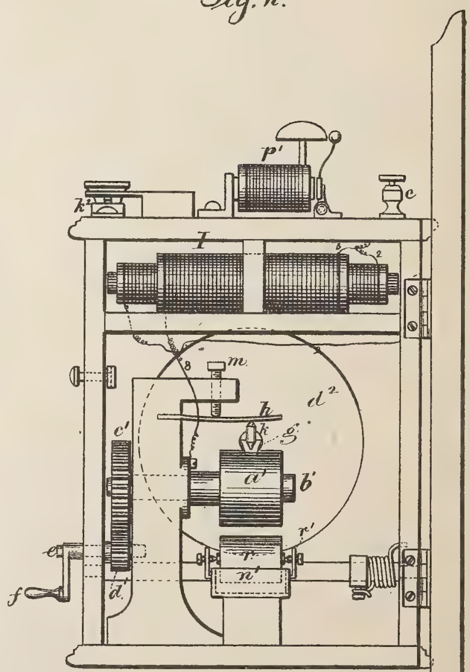
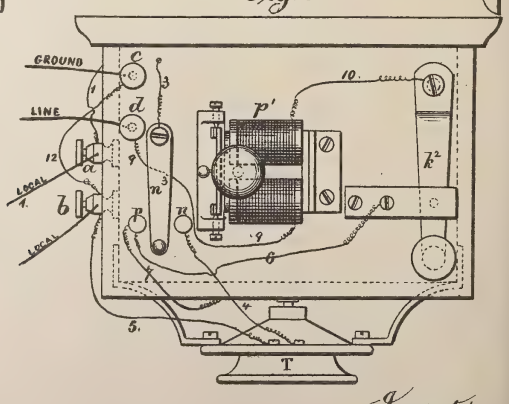


Fig. 3.



Witnesses
Chas. H. Smith
Harold Serrell

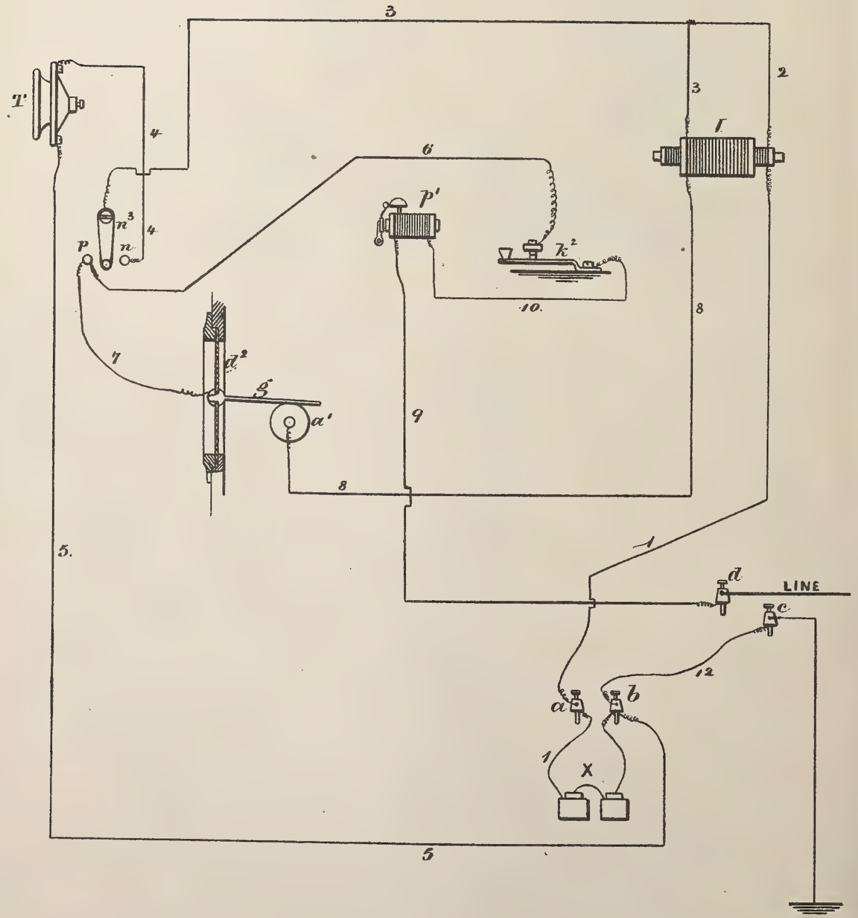
Inventor.
Thomas A. Edison
per Lemuel W. Serrell
att'y.

2 Sheets—Sheet 2.

T. A. EDISON.
Telephone.

No. 221,957. Patented Nov. 25, 1879.

Fig. 4



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison.
for Lemuel W. Serrell
atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN TELEPHONES.

Specification forming part of Letters Patent No. **221,957**, dated November 25, 1879; application filed March 31, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Telephones, (Case No. 175,) of which the following is a specification.

The object of this invention is to transmit sounds electrically to a distance and reproduce the same with great power and without loss of volume.

The peculiar action upon which this invention is based was patented by me January 19, 1875, and numbered 158,787. An application of this action to telephony was also applied for by me July 20, 1877, No. 141, in which there is a band of paper moving beneath a point connected to the diaphragm. This feature, therefore, is not broadly claimed herein.

The present application consists more particularly in devices which make the invention perfectly practicable for use in commerce, and render the same reliable and effective.

In the drawings, Figure 1 is a section of the apparatus. Fig. 2 is a view of the back of the box. Fig. 3 is a plan view, and Fig. 4 is a diagram representing the connections to the line, local circuit, and various parts of the apparatus.

a' is a cylinder of compressed chalk soaked in an electrolytic solution, such as a caustic alkali, that it may become a conductor of electricity. I will mention that any finely-divided non-conducting material or porous body having capillary pores, and which has no chemical action upon the absorbed solution, may be used. This cylinder is secured to a shaft, b', and the whole is rotated by the operator by means of the toothed wheels c' d', shaft e, and handle f. Worm and pinion may be substituted, and motor-power of a clock-work or analogous motor replace the hand of the operator.

Resting upon the cylinder a' is a flat spring, g, connected to the diaphragm d^2. This spring is pressed upon the chalk with a pressure of several pounds by means of the wire k and spring h, the screw m serving to increase or decrease the amount of pressure.

The line-wire is connected to the spring g, while the earth-wire is connected to the shaft on which the cylinder a' is secured. If, now, the cylinder be rotated in the direction shown by the arrow and no current passes, the normal friction of the spring g upon the surface of the cylinder a' will be very great, and the spring will be carried forward in the direction of the rotation of the cylinder, thus pulling inwardly the diaphragm d^2. If, now, a current passes whose direction is such that hydrogen will be produced upon the surface of the spring g in contact with the chalk, the friction will be reduced to an extent proportionate to the strength of the current; hence the diaphragm will regain its natural position and continue there as long as the current passes. If, now, the current ceases, the normal friction at once is re-established, and the traction increases, and the diaphragm is instantly pulled inwardly again. If, now, a current in the opposite direction is transmitted, the effect is scarcely noticeable, as the evolution of oxygen upon the surface of the spring g does not, except with a few saturations, decrease the friction like hydrogen, but, on the contrary, generally tends to increase the normal friction; hence I allow a constant current to circulate on the line, and am thus enabled to utilize the opposite waves by causing them to weaken the constant current, which is always in a direction to evolve hydrogen on the surface of the spring g.

If no constant current were upon the line, the waves in one direction only would produce a limited effect; but by using a constant current circulating upon the line in addition to the waves of similar and opposite polarity, one polarity of wave is added to that of the current, and the other wave neutralizes, or nearly neutralizes, the constant current; hence the tendency of one wave is to produce a lessening of friction of, say, five units, which, added to that produced by the constant current—say five—together give ten units. If, now, an opposite current is sent, it neutralizes the constant current, and we have the normal friction of the cylinder, whereas if no constant current were used one current would lessen the friction by five units, and the opposite current would perform no work.

n' is a receptacle containing water, and resting in the water is a roller, r, composed of any flexible absorbent substance, such as sponge or felt.

A lever, r', to which the roller is attached, and by which the roller may be brought in contact with the cylinder a', extends through the box to the outside. The object of this device is to supply the cylinder with water lost by evaporation, and make it a conductor to the electric current.

In practice, when all the apparatus is inclosed in a cast-iron case, the loss by evaporation is very small; and if the roller be held against the cylinder and the cylinder be rotated three or four times the chalk will take up sufficient moisture so that it will perform its functions for a week or more without again wetting it.

The connections are as follows: T is a carbon telephone-transmitter, placed in a local circuit with an induction-coil, I, and local battery X. If the position of the switch-lever n^3 is on the button n, then the current proceeds from the local battery X via wire 1, primary coil of I, wire 2 to 3; thence to the switch-lever n^3, wire 4, through the carbon transmitter T; thence by wire 5 to the post b; thence to the battery.

The sonorous waves of the voice are translated into electric waves of a positive and negative character in the secondary coil of the inductorium I in the well-known manner.

The connections of the main line are as follows: The line from the distant station enters at the post d; thence via wire 9 to the call-bell electro-magnet p'; thence via wire 10 to the key-lever k^2; thence by wire 6 to the point p of the switch, and by wire 7 to the spring g of the receiver; thence through the moist chalk to wire 8, to and through the secondary coil; thence via wire 3 to the switch-lever, which, it will be remembered, is in n; thence by wire 4 through the transmitter to wire 5; thence to post b, and by wire 12 to the post c, which is connected to the earth. I will mention that either of the posts d c may be connected to the ground or line.

It will be noticed that the main line passes through the transmitter, which is connected to the local battery; hence a portion of the current leaks into the main line, and it is this portion which thus leaks into the line that serves as a constant current for short lines; but if the line be too long, or has too great a resistance, this small leakage-current is so weakened as to be insufficient to produce a lessening of friction between the spring g and the chalk; hence I insert one or more cells in the main line.

While the switch is in this position—*i. e.*, the lever in contact with n—transmitting and receiving can go on simultaneously. By turning the switch-lever to the point p the telephonic apparatus is disconnected, and the call-bell apparatus p' becomes operative. The line enters at the point d, passes through the call-bell magnet via wire 9, and by 10 to key k^2; thence via 6 to p, and by switch to wire 3, and by 2 through the primary coil and via 1 to local battery, through that to post b, and by 12 to post c and to earth. By depressing the key k^2 the circuit is opened and closed, and the two local batteries—one at each end of the line—become operative to ring the bell.

I will mention that the two receivers herein described and the two transmitters may all be connected in one line and operated without the aid of induction-coils, but the results are not equal to that from the use of the coil; also, that the receivers will act as transmitters by reason of the fact that when the spring g and chalk are at rest the resistance of the whole is generally about twenty-five hundred ohms, and this resistance is reduced instantaneously to two hundred or three hundred ohms by the slightest movement of either the chalk or the spring; hence the movement of the diaphragm d^2 by the voice produces the same result, or nearly so, as the carbon transmitter. If advantage is to be taken of this fact, the surface of the spring g should be reduced to increase the effect, and an induction-coil having a primary coil of high resistance used in connection with the apparatus, although it is not absolutely necessary, as the direct results are nearly as good.

In preparing the chalk I prefer to use a salt of mercury mixed with caustic soda. The action takes place no matter what the proportions are. The mercury salt I prefer to use is the acetate of mercury.

I will mention that this moisture of the chalk may be regulated automatically by taking advantage of the fact that the normal friction of the chalk increases as it becomes drier.

A spring resting on the chalk is connected to the wetting-roller, and has such a pressure and counteracting spring that when the chalk has its proper moisture the friction during rotation is insufficient to produce the necessary traction to lift the roller; but when it becomes drier the traction becomes sufficient to lift the wetting-roller, and it supplies moisture until the traction is reduced below a certain point and it falls.

I claim as my invention—

1. The combination, with the acoustic telegraph and diaphragm, of a roller that receives a revolving motion and contains an electrolytic material, and a spring or presser connected with the diaphragm and resting upon the roller, substantially as set forth.

2. The combination, in an acoustic telegraph, of a moving surface containing electrolytic material, a diaphragm, a presser or spring extending from the diaphragm and resting on such surface, a screw through a fixed support acting upon the presser to vary or adjust the friction between the moving surface and the presser, substantially as set forth.

3. The roller a', revolved by power, and the

presser g and diaphragm d^2, in combination with the receptacle n' for liquid and the transfer-roller r, substantially as set forth.

4. The arrangement of local circuit, magnetic call, telephone-receiver, telephone-transmitter, switch, and line-connections, substantially as set forth, whereby the call and the receiving-instrument are in the line-circuit, and the local battery is also put upon the line, substantially as specified.

Signed by me this 24th day of March, A. D. 1879.

THOMAS A. EDISON.

Witnesses:

STOCKTON L. GRIFFIN,

WM. CARMAN.

T. A. EDISON.
Carbon Telephone.

No. 222,390. Patented Dec. 9, 1879.

Fig. 1.

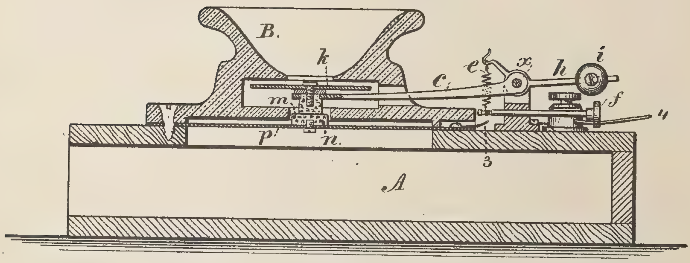
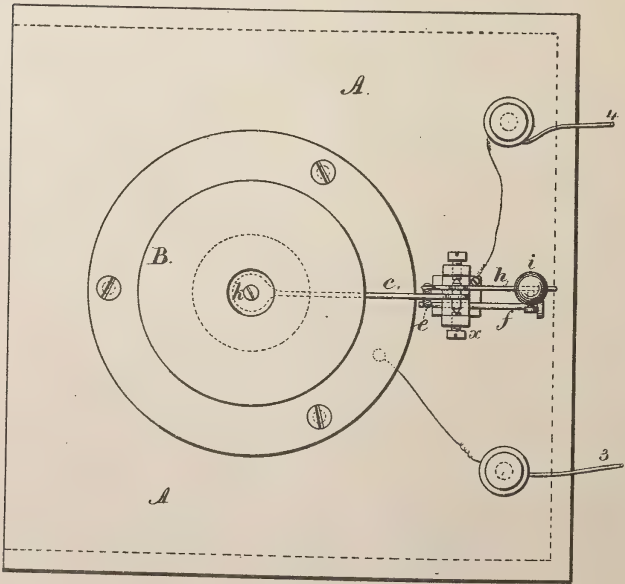


Fig. 2.



Witnesses
Chas. H. Smith
Geo. T. Pinckney

Inventor
Thomas Alva Edison
per Lemuel W. Serrell
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN CARBON-TELEPHONES.

Specification forming part of Letters Patent No. **222,390**, dated December 9, 1879; application filed November 11, 1878.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Telephones, of which the following is a specification.

This invention I term the "micro-telephone," in consequence of the same responding to minute vibrations of the instrument itself, transmitted to it by any solid body or of the atmosphere, and in so doing transmitting electric pulsations to a distance, where they can be received by an ordinary telephone.

In the drawings, Figure 1 is a section of the instrument, and Fig. 2 is a plan of the same.

The box A is of a suitable size and shape for holding the apparatus, and for acting as a resonant case, one side thereof being open. This case conveys to the apparatus any vibrations or disturbance resulting from the sound-vibrations of the atmosphere or from the vibration of the solid material upon which the box rests.

In the box A is an opening, preferably round, in which is the diaphragm *p*, and upon this diaphragm is a piece of compressed finely-divided conducting material, such as carbon, *n*. A second piece of carbon or similar material, *m*, is secured to a lever, *c*, the fulcrum or pivot of which is at *x*.

A lever-arm, *h*, and movable weight *i* may be employed to balance the lever *c* and parts connected therewith, and the delicate spring *e* and adjusting-spindle *f* serve to increase or decrease the pressure of the buttons *m n* upon each other.

The plate *k*, of light material, such as mica, is connected with the lever *c*, and this is within and protected by a funnel or mouth-piece, B, upon the box A.

It is now to be understood that the slightest vibration or jar given to the apparatus, such as that resulting from walking about a room, or from the articulate speech or sound-vibrations, vary the pressure of *m n* upon each other, and in so doing the electric condition of a circuit passing through *p n m c* and wires 3 4 is varied, and a corresponding response occurs in a distant receiving-telephone. The finely-divided carbon or other material between *k* and *p* thus becomes a circuit-regulator, that acts to vary the resistance in proportion to the vibration of the parts.

This transmitter is either included in a short circuit containing a receiving-telephone and battery, or in the primary circuit of an induction-coil containing a battery, and whose secondary coil is in the line-wire containing the receiving-telephone.

In my application No. 141, filed July 20, 1877, I have shown a diaphragm and a spring carrying one electrode, and also a second electrode; and in my application No. 178, filed June 2, 1879, I have shown a diaphragm and two springs, with carbon between them. I do not herein lay claim to any of the devices shown in either of the said applications.

I claim as my invention—

1. The combination, with a resonant case or support, of the carbon or similar material, the lever *c*, disk *k*, and circuit-connections, substantially as set forth.

2. The combination of two moving plates or diaphragms, *p* and *k*, with finely-divided carbon or similar material intervening, and the circuit-connections passing through the same, substantially as set forth.

3. The combination, with a resonant case, of two diaphragms or plates, *p* and *k*, upon which sound or other vibrations operate, and a circuit-regulator of finely-divided carbon or other material placed between such plates *k* and *p* and the circuit-connections, substantially as set forth.

Signed by me this 8th day of November, A. D. 1878.

THOMAS A. EDISON.

Witnesses:

S. L. GRIFFIN,

CHAS. BATCHELOR.

T. A. EDISON.

Magneto-Electric Machine.

No. 222,881. Patented Dec. 23, 1879.

Fig. 1.

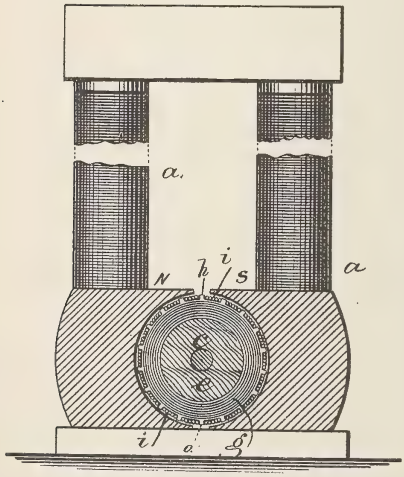


Fig. 3.

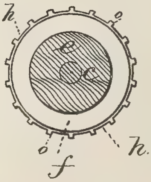


Fig. 4.

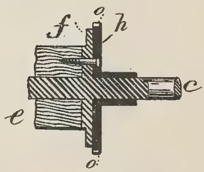


Fig. 2.

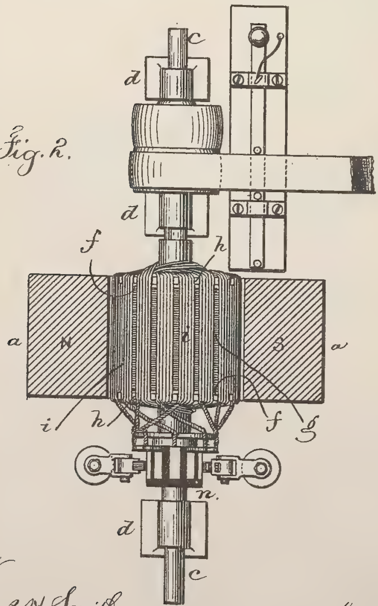
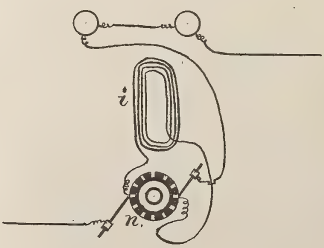


Fig. 5



Inventor

Thomas A. Edison.

per Lemuel W. Serrell

atty.

Witnesses

Chas H. Smith

Geo. T. Pinckney

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN MAGNETO-ELECTRIC MACHINES.

Specification forming part of Letters Patent No. **222,881**, dated December 23, 1879; application filed September 10, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Magneto-Electric Machines, (Case 184,) of which the following is a specification.

The object of this invention is to increase the effectiveness and cheapen the construction of the revolving armature.

I make the revolving armature of a cylinder of wood with two iron heads, and around the cylinder and between the heads fine iron wire is wound.

At the ends of the cylinder, outside the iron heads, there are disks of hard rubber or other insulating material, and the wires forming the induction-helix are wound lengthwise of the cylinder into notches in the edges of the disk. This insures the proper insulation of the induction-helix, even if the insulating-covering of the wires may be injured, and the fine iron-wire cylinder forms a magnet by induction from the field-of-force magnet, and the wires running circumferentially also set up magnetic poles in the revolving armature, and with the aid of the commutator the magnetic poles always remain at the right place on account of the quick discharging time of the iron-wire magnet, and therefore are practically regardless of the speed of revolution, and render it unnecessary to adjust the commutators for different speeds of revolution.

In the drawings, Figure 1 is an elevation of the field-of-force magnet with the poles and armature-cylinder in section. Fig. 2 is a plan of the armature-cylinder with the poles in section. Fig. 3 represents the wooden cylinder sectionally without the wire helix. Fig. 4 is a section of one end of the armature-cylinder, and Fig. 5 is a diagram of the circuit-connections.

The field-of-force magnet *a* is provided with the poles N S, and the same may be either a permanent magnet or electro-magnet, but preferably the latter, and the helix thereof in the circuit from the armature-helix; or it may be energized separately. The pole-faces are concave.

The shaft *c* is in bearings *d*, and has a wooden cylinder, *e*, between the two iron heads *f*, and *g* is the helix of iron wire wound into the space between the heads *f*.

The insulating-heads *h*, of hard rubber, vulcanized fiber, or equivalent material, are secured outside the heads *f*, and are of larger diameter, so that the helix-wires *i*, that are wound longitudinally, may be kept from contact with the iron helix *g* or heads *f*, so that the current may not be short-circuited, even if the insulation of the wires *i* is defective.

The projections *o* around the heads *h* serve as guides to retain the wires that are wound into the notches between said projections.

The longitudinal wires *i* are connected to the commutator-plates *n*, from which the brushes pass the current to the binding-screws, and thence to the object that is to be supplied with the electric current.

The wires *i* may be wound in the manner set forth in my application No. 177.

In use the poles N S of the field-magnet energize, by induction, the iron-wire helix *g*, and the wires of the armature-coil *i* are carried across or cut the lines of magnetism, so as to obtain a maximum effect in setting up a current in said induction-helix.

The bobbin, after winding, is served with German-silver wire in several places to keep the induction-wires against the cylinder.

I do not claim a dynamo-magneto-electric machine wherein a cylindrical armature coiled with insulated wire wound longitudinally on the exterior thereof and provided with a commutator is caused to rotate between curved branches of electro-magnets, the coils of which are in electric circuit from the commutator to the terminals of the machine, as I prefer not to include the helix of the field-magnet in the circuit from the commutator.

I claim as my invention—

The cylinder *e*, of wood or similar material, with the iron heads *f* and intervening helix of fine iron wire, in combination with the disks *h* of non-conducting material and the induction-helix *i*, wound lengthwise and into notches in the edges of the insulating-disks, substantially as set forth.

Signed by me this 4th day of September, A. D. 1879.

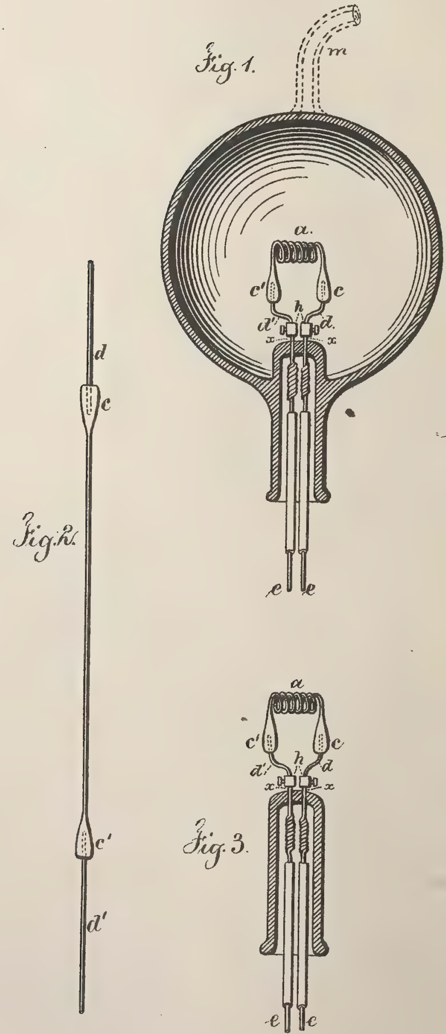
THOS. A. EDISON.

Witnesses:
S. L. GRIFFIN,
FRANK MCLAUGHLIN.

18

T. A. EDISON.
Electric-Lamp.

No. 223,898. Patented Jan. 27, 1880.



Witnesses
Chas H Smith
Geo T Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
att'y.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 223,898, dated January 27, 1880.

Application filed November 4, 1879.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, United States of America, have invented an Improvement in Electric Lamps, and in the method of manufacturing the same, (Case No. 186,) of which the following is a specification.

The object of this invention is to produce electric lamps giving light by incandescence, which lamps shall have high resistance, so as to allow of the practical subdivision of the electric light.

The invention consists in a light-giving body of carbon wire or sheets coiled or arranged in such a manner as to offer great resistance to the passage of the electric current, and at the same time present but a slight surface from which radiation can take place.

The invention further consists in placing such burner of great resistance in a nearly-perfect vacuum, to prevent oxidation and injury to the conductor by the atmosphere. The current is conducted into the vacuum-bulb through platina wires sealed into the glass.

The invention further consists in the method of manufacturing carbon conductors of high resistance, so as to be suitable for giving light by incandescence, and in the manner of securing perfect contact between the metallic conductors or leading-wires and the carbon conductor.

Heretofore light by incandescence has been obtained from rods of carbon of one to four ohms resistance, placed in closed vessels, in which the atmospheric air has been replaced by gases that do not combine chemically with the carbon. The vessel holding the burner has been composed of glass cemented to a metallic base. The connection between the leading-wires and the carbon has been obtained by clamping the carbon to the metal. The leading-wires have always been large, so that their resistance shall be many times less than the burner, and, in general, the attempts of previous persons have been to reduce the resistance of the carbon rod. The disadvantages of following this practice are, that a lamp having but one to four ohms resistance cannot be worked in great numbers in multiple arc without the employment of main conductors of enormous dimensions; that, owing to the low resistance of the lamp, the leading-wires must be of large dimensions and good conductors, and a glass globe cannot be kept tight at the place where the wires pass in and are cemented; hence the carbon is consumed, because there must be almost a perfect vacuum to render the carbon stable, especially when such carbon is small in mass and high in electrical resistance.

The use of a gas in the receiver at the atmospheric pressure, although not attacking the carbon, serves to destroy it in time by "air-washing," or the attrition produced by the rapid passage of the air over the slightly-coherent highly-heated surface of the carbon. I have reversed this practice. I have discovered that even a cotton thread properly carbonized and placed in a sealed glass bulb exhausted to one-millionth of an atmosphere offers from one hundred to five hundred ohms resistance to the passage of the current, and that it is absolutely stable at very high temperatures; that if the thread be coiled as a spiral and carbonized, or if any fibrous vegetable substance which will leave a carbon residue after heating in a closed chamber be so coiled, as much as two thousand ohms resistance may be obtained without presenting a radiating-surface greater than three-sixteenths of an inch; that if such fibrous material be rubbed with a plastic composed of lamp-black and tar, its resistance may be made high or low, according to the amount of lamp-black placed upon it; that carbon filaments may be made by a combination of tar and lamp-black, the latter being previously ignited in a closed crucible for several hours and afterward moistened and kneaded until it assumes the consistency of thick putty. Small pieces of this material may be rolled out in the form of wire as small as seven-one-thousandths of an inch in diameter and over a foot in length, and the same may be coated with a non-conducting non-carbonizing substance and wound on a bobbin, or as a spiral, and the tar carbonized in a closed chamber by subjecting it to high heat, the spiral after carbonization retaining its form.

All these forms are fragile and cannot be clamped to the leading-wires with sufficient force to insure good contact and prevent heating. I have discovered that if platinum wires are used and the plastic lamp-black and tar

material be molded around it in the act of carbonization there is an intimate union by combination and by pressure between the carbon and platina, and nearly perfect contact is obtained without the necessity of clamps; hence the burner and the leading-wires are connected to the carbon ready to be placed in the vacuum-bulb.

When fibrous material is used the plastic lamp-black and tar are used to secure it to the platina before carbonizing.

By using the carbon wire of such high resistance I am enabled to use fine platinum wires for leading-wires, as they will have a small resistance compared to the burner, and hence will not heat and crack the sealed vacuum-bulb. Platina can only be used, as its expansion is nearly the same as that of glass.

By using a considerable length of carbon wire and coiling it the exterior, which is only a small portion of its entire surface, will form the principal radiating-surface; hence I am able to raise the specific heat of the whole of the carbon, and thus prevent the rapid reception and disappearance of the light, which on a plain wire is prejudicial, as it shows the least unsteadiness of the current by the flickering of the light; but if the current is steady the defect does not show.

I have carbonized and used cotton and linen thread, wood splints, papers coiled in various ways, also lamp-black, plumbago, and carbon in various forms, mixed with tar and kneaded so that the same may be rolled out into wires of various lengths and diameters. Each wire, however, is to be uniform in size throughout.

If the carbon thread is liable to be distorted during carbonization it is to be coiled between a helix of copper wire. The ends of the carbon or filament are secured to the platina leading-wires by plastic carbonizable material, and the whole placed in the carbonizing-chamber. The copper, which has served to prevent distortion of the carbon thread, is afterward eaten away by nitric acid, and the spiral soaked in water, and then dried and placed on the glass holder, and a glass bulb blown over the whole, with a leading-tube for exhaustion by a mercury-pump. This tube, when a high vacuum has been reached, is hermetically sealed.

With substances which are not greatly distorted in carbonizing, they may be coated with a non-conducting non-carbonizable substance, which allows one coil or turn of the carbon to rest upon and be supported by the other.

In the drawings, Figure 1 shows the lamp sectionally. *a* is the carbon spiral or thread. *c c'* are the thickened ends of the spiral, formed of the plastic compound of lamp-black and tar. *d d'* are the platina wires. *h h* are the clamps, which serve to connect the platina wires, cemented in the carbon, with the leading-wires *x x*, sealed in the glass vacuum-bulb. *e e* are copper wires, connected just outside the bulb to the wires *x x*. *m* is the tube (shown by dotted lines) leading to the vacuum-pump, which, after exhaustion, is hermetically sealed and the surplus removed.

Fig. 2 represents the plastic material before being wound into a spiral.

Fig. 3 shows the spiral after carbonization, ready to have a bulb blown over it.

I claim as my invention—

1. An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described, and secured to metallic wires, as set forth.

2. The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air is exhausted, for the purposes set forth.

3. A carbon filament or strip coiled and connected to electric conductors so that only a portion of the surface of such carbon conductors shall be exposed for radiating light, as set forth.

4. The method herein described of securing the platina contact-wires to the carbon filament and carbonizing of the whole in a closed chamber, substantially as set forth.

Signed by me this 1st day of November, A. D. 1879.

THOMAS A. EDISON.

Witnesses:

S. L. GRIFFIN,

JOHN F. RANDOLPH.

T. A. EDISON.

Electric-Lighting Apparatus.

No. 224,329. Patented Feb. 10, 1880.

Fig. 1.

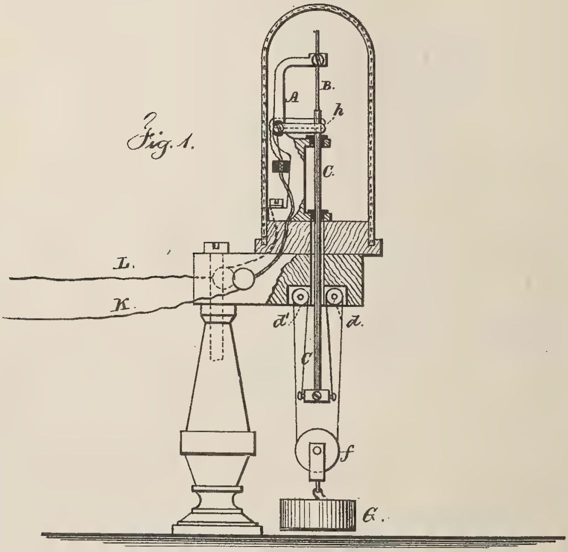


Fig. 3.

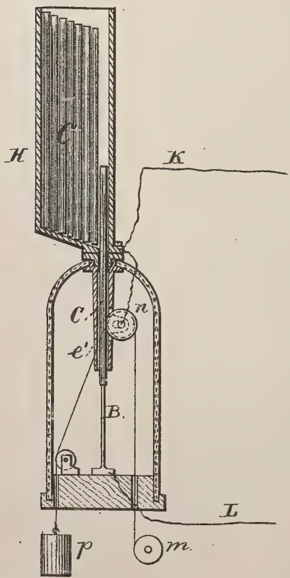
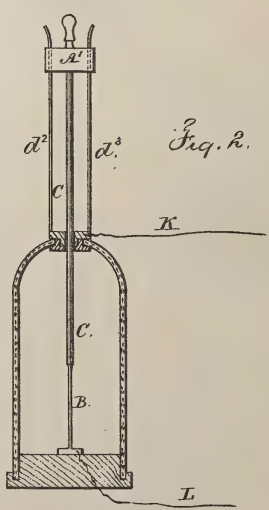


Fig. 2.



Witnesses

Chas. H. Smith

Geo. T. Pinckney

Inventor

Thomas A. Edison

per Lemuel W. Serrell att.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC-LIGHTING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 224,329, dated February 10, 1880.

Application filed February 3, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Electric-Lighting Apparatus, (Case No. 170;) and the following is declared to be a description of the same.

The object of this invention is to produce electric illumination by the incandescence of carbon.

The invention consists in making the two poles dissimilar, one being of the carbon in the form of a slender rod, and which serves to give light, while the other is of platinum or platinum-iridium alloy, against which the rod presses.

The inferiority of contact which takes place between the metal and the carbon creates a considerable resistance, which, heating the carbon, increases the inferiority of the contact, causing the carbon to become highly incandescent; but no effect is produced upon the platinum or iridium alloy.

In Figure 1, A is the frame-work; B, the platina pole; C, the carbon rod. *h h* are springs, which rub upon the carbon rod, and are the medium of conveying a current to it by the wires K from the binding-post, the platina rod B and frame A being connected to the other binding-post by the wire L.

d' and *d* are wheels, over which cords or strings run. These strings are connected to the extreme end of the carbon C, and to the pulley *f* and weight G. The effect of the weight is to cause the carbon rod C to press at all times against the platina or iridium rod B.

The carbon rod is insulated from the frame A in any suitable manner, and it will be apparent that as the carbon rod is consumed the weight G moves the carbon upwardly to maintain contact with metallic rod B.

In Fig. 2 is shown a method whereby the carbon rod C is fed downward by means of a weight, A', resting upon the upper end of the carbon and guided by the springs or rods d^2 d^3. Electrical contact is maintained with the weight and carbon by the springs d^2 d^3, or in any other suitable manner.

In Fig. 3 a magazine-lamp is shown. C C C are rods of carbon contained in the case H, which rods rest at their lower end upon the inclosed bottom of the case H and slide toward the tube *e'*, into which the rods pass one at a time by their own weight. *n* is a feed-wheel, that acts through an opening at one side of the tube *e'* upon the carbon rod; *p*, a weight, and *m* a spool or coil of thread or fine wire, with a slight friction from a spring or otherwise, to prevent the thread unwinding too easily. This thread passes around the wheel *n*, or a drum on its shaft, and is constantly drawn upon by the weight *p*, so as to move the carbon rod downwardly and keep it in contact with the metal rod B.

It is obvious that a clock-work movement which will run for several days, or an electric engine included in the same circuit, may give motion to the feed-wheel *n*.

I am aware that in some instances the carbon rod has been forced into contact with a large bar tipped with platina. I make use of a rod of platina or iridium that is smaller than the carbon, so as to produce a resistance at the point of contact between the carbon and platina in consequence of the inferior contact, and thereby develop incandesence at this point.

I am also aware that rods of carbon have been supplied automatically from a holder. Therefore I do not claim the same.

I claim as my invention—

1. The combination, with the carbon rod, in an electric lamp, of a metal rod that is difficult of fusion and smaller than the carbon rod, so as to produce a resistance at the point of contact between the carbon and the metal, and a weight to maintain the necessary pressure at the point of contact, substantially as set forth.

2. The case H, having an inclined bottom and adapted to receive several carbon rods, in combination with the metallic rod B and means for guiding the carbon and maintaining the pressure thereof at the point of contact, substantially as set forth.

Signed by me this 23d day of January, A. D. 1879.

THOMAS A. EDISON.

Witnesses:
S. L. GRIFFIN,
WM. CARMAN.

T. A. EDISON.

Method of Preparing Autographic Stencils for Printing.

No. 224,665. Patented Feb. 17, 1880.

Fig. 1.

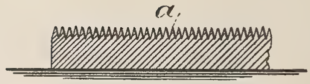


Fig. 2.

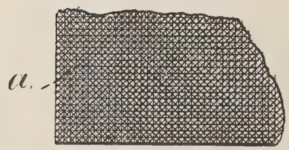


Fig. 3.

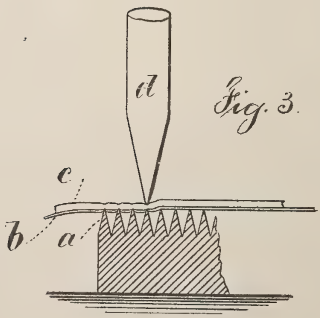
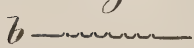


Fig. 4.



Witnesses

Chas. H. Smith

Geo. T. Pinckney

Inventor

Thos. A. Edison

per L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

METHOD OF PREPARING AUTOGRAPHIC STENCILS FOR PRINTING.

SPECIFICATION forming part of Letters Patent No. 224,665, dated February 17, 1880.

Application filed March 17, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Preparing Stencils for Printing, (Case No. 173,) of which the following is a specification.

In Letters Patent No. 180,857, granted to me, means for perforating paper by a rapidly-reciprocating needle are set forth; also, a method of printing by forcing a semi-fluid ink through the perforations.

My present invention relates to a peculiar stencil-sheet, and to the method of and a means for preparing the perforated stencil of paper or similar material.

I make use of a slab or plate with a surface of numerous sharp points. Such surface is represented at *a* composed of needle-points set closely together, or wire points, the extreme ends of which are in the same plane and the bodies united by solder or cast metal; or the said surface may be a metal plate with its surface scored with grooves that leave the intervening sharp points projecting, as shown in the section, Figure 1, and plan, Fig. 2. A steel plate thus prepared and hardened is preferred.

Upon this slab the sheet of paper *b* is placed, and upon it, by preference, a sheet of blotting-paper, *c*, or other soft paper or material, is laid, and the person that writes or draws makes use of a stylus or blunt point, *d*, and writes or draws upon the surface of the paper *c* by pressing the same by hand thereon with a force that is sufficient to cause the points of the slab *a* to penetrate the paper *b* upwardly in the lines beneath the stylus. The sectional view, Fig. 3, illustrates this method of preparing the stencil.

The perforations in the paper will have their largest diameter at the under side of the sheet, as shown in the section, Fig. 4, in consequence of each point in the slab *a* being tapering; hence, when the paper stencil is made use of in printing with a semi-fluid ink, such ink will pass in at the smallest part of each hole to the broader part of the hole adjacent to the paper, and the lines of dots will be sufficiently heavy and distinct when printed upon the surface that is printed.

I do not limit myself to the use of the sheet of soft paper *c*, as the writing may be done directly upon the surface of the sheet *b*, and any suitable blunt pencil or stylus may be used. In some instances the pencil may be of wood or other yielding material; or a lead-pencil may be employed.

A method of printing by a perforated stencil having been set forth in my aforesaid patent does not require to be repeated herein. I remark that the ink may be rubbed into or forced through the perforations of the stencil in any desired manner, so as to print upon a sheet of paper laid beneath the perforated stencil.

The stylus may be provided with a small roller at the lower end or a ball in a socket. This roller or ball should be of yielding material, such as leather or rawhide.

I claim as my invention—

1. The method herein specified of preparing stencil-sheets for printing, consisting in pressing the sheet in the lines to be printed against the numerous fine perforating-points of a slab by means of a blunt stylus that is passed over the sheet at the lines to be perforated and forces such sheet upon the points, substantially as set forth.

2. As an appliance for puncturing stencil-sheets by the aforesaid method, the slab *a*, having a surface composed of numerous and closely-proximate penetrating-points, in combination with a blunt stylus adapted to be moved by hand over the paper to be perforated, substantially as set forth.

3. An autographic stencil-sheet, substantially as described, for multiplicate printing, having perforations that are the largest at the side next the surface to be printed, substantially as set forth.

Signed by me this 10th day of March, A. D. 1879.

THOMAS A. EDISON.

Witnesses:
S. L. GRIFFIN,
G. E. CARMAN.

(No Model.)

T. A. EDISON.

Safety-Conductor for Electric-Lights.

No. 227,226. Patented May 4, 1880.

Fig. 1.

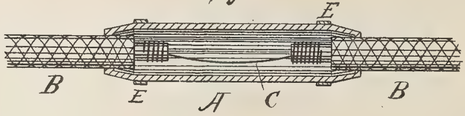


Fig. 2.

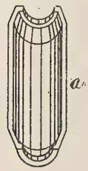
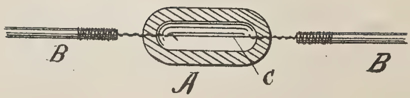


Fig 3.



Attest:-

Saml D. Mott

James A. Payne.

Inventor:-

T. A. Edison

per

Dyer & Wilber

Attys

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SAFETY-CONDUCTOR FOR ELECTRIC LIGHTS.

SPECIFICATION forming part of Letters Patent No. 227,226, dated May 4, 1880.

Application filed March 25, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Conductors for Electric Lights; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In other applications for patents made by me I have shown a safety device for preventing an abnormal flow of current through any branch. This safety device consists of a piece of very small conductor interposed in the main conductors of a house or in the derived circuit of a lamp. Preferably, one is interposed in the circuit of each lamp or other translating device. This small conductor has such a degree of conductivity as to readily allow the passage of the amount of current designed for its particular branch, but no more. If, from any cause whatever, an abnormal amount of current, large enough to injure the translation devices or to cause a waste of energy, is diverted through a branch the small safety-wire becomes heated and melts away, breaking the overloaded branch circuit. It is desirable, however, that the few drops of hot molten metal resulting therefrom should not be allowed to fall upon carpets or furniture, and also that the small safety-conductor should be relieved of all tensile strain; hence I inclose the safety-wire in a jacket or shell of non-conducting material, which, preferably, is secured to the ends of the large conductors, uniting them, not electrically, but as to tensile strain.

In the drawings, Figures 1 and 3 show different forms of jacket or shell, and Fig. 2 is a section or half of the form shown in Fig. 1.

B B is the main or ordinary conductor, severed, as shown, and C is the safety device or wire, capable of conducting the current ordinarily used in its particular circuit, but melting and thereby breaking the circuit when the current is injuriously increased.

In Fig. 3 A is a simple shell placed over the safety-wire only. The preferable form is shown in Fig. 1, where A is a shell composed of two halves, *a*, one of which is shown in Fig. 2. This shell is made slightly tapering at the ends, and with a slight inward flange, so as to grasp firmly the wire B B.

The two halves are placed so as to form a complete cylinder, the ends grasping the wire B B, and the hoops or bands E E slipped on.

This arrangement forms a shell or case for the safety-wire, and at the same time relieves it of tensile strain, the strain of the wire B B being carried by the case.

What I claim is—

1. The combination, with the safety wire or device, of an inclosing case or shell, substantially as set forth.

2. The combination, with the safety-wire and main severed conductor, of a shell or case inclosing the safety device or wire and relieving it from strain, substantially as set forth.

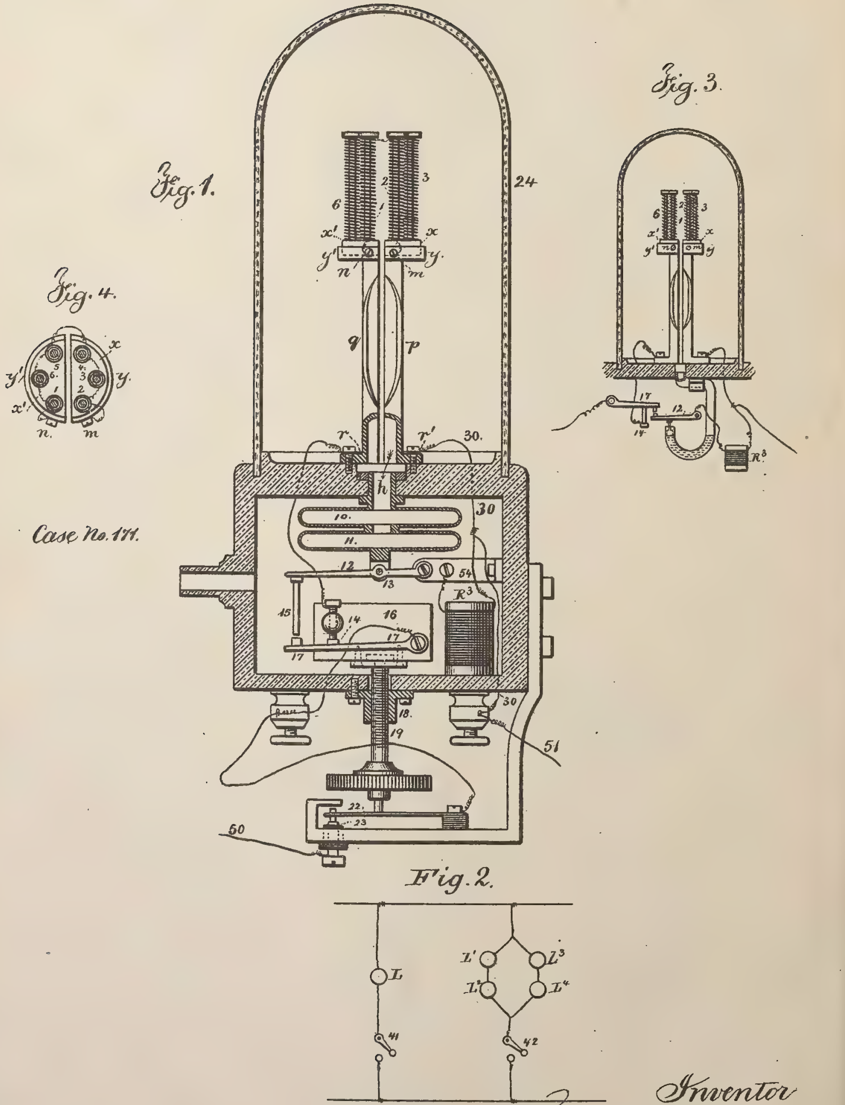
This specification signed and witnessed this 10th day of March, 1880.

THOS. A. EDISON.

Witnesses:
WM. CARMAN,
C. P. MOTT.

T. A. EDISON.
Electric-Lights.

No. 227,227. Patented May 4, 1880.



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LIGHT.

SPECIFICATION forming part of Letters Patent No. 227,227, dated May 4, 1880.

Application filed February 10, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Electric Lights, (Case No. 171,) of which the following is a specification.

The object of this invention is to economically apply electricity to lighting and to insure uniformity of action in the different lamps.

The invention consists, first, in an improved incandescent lamp and regulator; second, in an automatic switch connected with the regulator of the lamp to connect it with the line; third, in grouping several lamps in such a manner that their combined resistance shall be the same as one lamp.

Figure 1 represents the lamp and the circuit-connections. 1, 2, 3, 4, 5, and 6 are coils of wire—preferably flattened wire formed of an alloy of platinum and iridium, or metallic nickel. There are six of these coils, (see Fig. 4,) each of which is slipped over a pencil of pipe-clay, which may be provided at the top end with a head, as shown in Fig. 1.

These pipe-clay pencils are secured to pipe-clay disks *x x'*, resting in the split metal cup *y y'*. Coil No. 2 has its lower end connected to the binding-screw *m* of the cup *y*. The top end of the spiral 2 connects to the spiral 3, the bottom of 3 to 4, the top of 4 to 5, the bottom of 5 to 6, the top of 6 to 1. The bottom of 1 connects to the screw *n* of the brass cup *y'*.

q and *p* are electric conductors between the divided cup *y y'* and the divided base *r* and *r'*, and at the same time serve as supports to the burner.

The wire of the coils as it comes from the winding-machine is stretched to open the coils, and then dipped in a thick milky solution of zircon oxide and clay and then passed through a hydrogen flame. This causes a very slight coating to adhere to the wire.

The coils are pressed together and placed on the fire-clay pencils, and the coils are confined between the heads of the fire-clay pencils and the clay blocks *x x'*, into holes in which blocks the ends of such fire-clay pencils are pressed. The coils forming the spirals are thus in contact, or nearly so, but they do not connect electrically; hence the current passes through the whole length of the wire. The expansion of the pencil of clay, or clay and zircon, is about equal to that of the metal coils; hence their condition is not materially altered by the heat.

The spirals are of such a size that they nearly touch each other. Hence the light and heat are confined within the circular range of spirals, and aid in intensifying the light and heat of the electric candle, and the radiation is mostly from the outside portions of the coils.

The pipe-clay disks *y y'* serve both for holding the pencils and preventing the lower ends of the spirals from cooling by having their heat conducted downward by the metal supports *q p*.

24 is a glass globe or shade set over the burner, and made air-tight, or nearly so. Air can only pass through the orifice *h*, as shown by the arrow.

The regulation by the electric current, and the consequent temperature of the burner, is obtained by the expansion of the air contained in the glass shade 24.

10 and 11 are flexible chambers, similar to those used in an aneroid-barometer. The expansion of the air by the heat of the burner causes these chambers to bulge outwardly and gives a downward motion to the lever 12, which is secured to the chamber 11 at 13.

15 is a long rod tipped with platinum. 14 is a contact-point, and the lever 17 usually rests against it; but when the heat of the burner has reached its maximum point it has expanded the air sufficiently to cause the lever 12 and point 15 to separate the lever 17 from 14 and divert the electric current from the lamp.

When the lamp is in operation the current passes from wire 50 to point 23, which is in contact with the spring 22, (the regulator-screw 19 keeping 22 and 23 in contact;) thence the current passes to binding-post and lever 17; thence to contact-point 14, to *r*, through the spirals to *r'*; thence by wire 30 to the other binding-post, and out by wire 51.

If, now, the temperature of the spirals becomes too great, the lever 12 and point 15 are thrown downward, and the lever 17 separated

from point 14, thus throwing the lamp entirely out of circuit and placing in circuit a resistance, R^3, equal to it, the object of the resistance being to prevent an excessive spark at the contact-points.

I remark that if the current is accurately circulated for the lamp the resistance of R^3 may be much greater than the lamp, and such resistance may even be in the form of several spirals placed between the spirals 1, 2, 3, 4, 5, and 6.

When the lever 17 is in contact with the point 15 and lever 12, the current passes by wire 50 to 23; thence through 22 to binding-post, to 17; thence through 15 and 12 to the coil R^3 by wire 54; thence by wire 30 to the binding-post, and out by wire 51.

The block 16, upon which the lever 17 and point 14 are attached, is movable, and it is adjusted by means of the screw 19, that passes through the stationary nut 18. By moving this block 16 toward the lamp the circuit is broken to the candle and closed through 15 and 17, and in so doing the circuit from 50 is broken between the spring 22 and screw-point 23. The reverse movement causes the lamp to be automatically connected to the circuit when the regulator-screw is turned downward to light the lamp.

The parts can be so arranged that the lamp will be disconnected when it is giving a light equal to about two-candle power.

In Fig. 2 are shown switches 41 and 42, whereby the lamps may be disconnected from the circuit after being turned down, as shown in my previous application, No. 169.

It is obvious that any of the various forms of thermal circuit-regulator already described in my previous patents may be combined with the burner herein shown.

In Fig. 3 is shown the before-described lamp with mercury substituted for the aneroid-chambers.

In Fig. 2 I have shown a single lamp, L, having, say, one thousand ohms resistance, placed in one branch, and in another branch I have shown four electric candles or burners, $L' L^2 L^3 L^4$, in one lamp. The burner being in close proximity and arranged in two branch circuits, the resistance of each branch being two thousand ohms, the two branches will jointly offer a resistance of one thousand ohms, the same as the resistance of the one lamp L.

By this arrangement various numbers of lamps may be placed in branch circuits between the same main conductors and the resistance be equal in each branch.

In my application for a patent No. 162 I have shown a glass shade in which the air is confined, and acts by its expansion upon a diaphragm to operate the electric-circuit regulator, and in my application No. 162 I have represented the confined air as acting upon a column of mercury, and in my application for a patent No. 166 I have shown the lamp as composed of a flattened coil of wire, and in my application No. 169 I have shown a rheostat or resistance that is thrown into the circuit when the lamp is extinguished.

I claim as my invention—

1. The combination, with the electric lamp and its transparent shade, of the aneroid-chambers 10 and 11 and electric-circuit regulator, substantially as set forth.

2. In an electric lamp, the combination, with a core of pipe-clay or equivalent non-conducting material and a base of similar material, to which the core is connected, a helix of platina or equivalent material surrounding the core and the wires of the electric circuit connected thereto, substantially as set forth.

3. In an electric lamp, a circular range of parallel helices connected alternately at top and bottom, and at the ends to the electric conductors, substantially as set forth.

4. The combination, in an electric lamp, of the divided base $r\ r'$, standards $p\ q$, divided cup $y\ y'$, and a circular range of parallel helices and circuit-connections, substantially as set forth.

5. The combination, with the electric lamp and thermal circuit-regulator, of the movable block 16, levers 12 and 17, contact-points 14 15, adjusting-screw 19, rheostat R^3, and circuit-connections, substantially as and for the purposes set forth.

6. The automatic switch 22 23, in combination with the screw 19, block 16, circuit-connections, thermal circuit-regulator, and electric lamp, substantially as set forth.

7. The arrangement of four electric lamps in a divided branch circuit between two main conductors, substantially as and for the purposes set forth.

Signed by me this 6th day of February, A. D. 1879.

THOMAS A. EDISON.

Witnesses:
STOCKTON L. GRIFFIN,
WM. CARMAN.

T. A. EDISON.
Electric-Lights.

No. 227,228. Patented May 4, 1880.

Fig. 1.

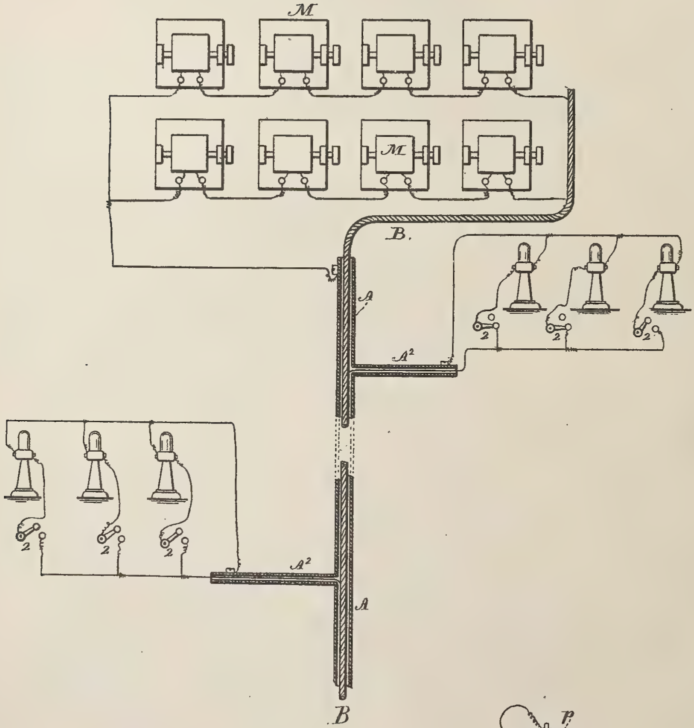
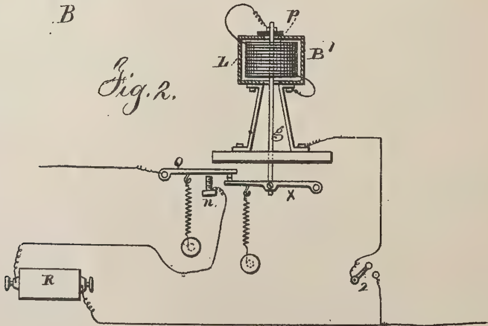


Fig. 2.



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
att'y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LIGHT.

SPECIFICATION forming part of Letters Patent No. 227,228, dated May 4, 1880.

Application filed February 3, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Electric Light, (Case No. 169,) of which the following is a specification.

In my Patents Nos. 214,636, 219,628, and 218,866 the expansion of metal under heat is availed of in regulating the electric circuit, and hence the same is disclaimed herein.

In my present electric lamp I make use of a coil of wire with a pyroinsulating material between the coils similar to that set forth in my application No. 166, which pyroinsulation is disclaimed herein; but I combine therewith a surrounding case that is rendered incandescent by the heat of the coil, and I combine with the lamp a thermal-circuit regulator arranged so that the amount of light can be varied at pleasure by an adjusting-screw that regulates the point at which the thermal regulator acts to open the electric circuit and lessen the current, so that the incandescent case can be more or less luminous.

The invention also consists in a lamp which is peculiarly adapted to use in multiple arc.

In the drawings, Figure 1 is a diagram illustrating the connections, and Fig. 2 shows the peculiar lighting apparatus.

The magneto-electric machines may be of any suitable character and driven by power. They may be arranged between the two main conductors A B in ranges or multiple arcs of three, four, or more in each, and the connections should be made for intensity. I have represented four such magneto-electric machines, M, in each range.

A is a tube laid in the earth, and preferably of iron, and it forms, together with the earth, one-half of the circuit. Within this tube is an insulated conductor, B, preferably of a number of strands of copper twisted together in the form of a cable, one strand of the cable being dropped, say, every one hundred feet, so that at the extreme end of the circuit there shall be but a single strand. This cable is insulated from the tube by any cheap or economical insulation, such as tar or asphaltum.

A branch tube, A^2, containing a single strand from the cable, is to enter each house or building, and from the basement smaller wires are run to the various parts of the house where the lights are required. Each lamp is to be provided with a switch, 2, so that it may be disconnected from the conducting-wires.

The electric generators at the central station are provided with constant field-of-force magnets, the helices of which are in the electric circuit; hence if all the lamps feeding from the main conductors are disconnected by their switches the circuit will be broken and no current passes through the conductors leading from the station to the lights, and the steam-engine runs lightly and with the expenditure of a very small amount of force. If now the switch of a single lamp is turned the lamp is connected to the branch wires from the main conductors, the circuit is closed, and only sufficient current passes from the central station to supply that lamp, because the external resistance determines the amount of current. In this way the current will be proportioned to the number of lamps in the circuit.

Each lamp I prefer to contain a resistance when incandescent of one thousand ohms. After the switch has been turned on so as to connect the light to the conductors the current will pass through a resistance, R, equal to the lamp; but if the thermal regulating-screw *n* be turned downward the lamp will be thrown in circuit and the current divided according to the extent to which the regulating-screw has been turned downward; if but slightly the lamp will only reach, say, a red heat, when, owing to the expansion of the regulating-rod *g*, the lamp will be thrown out of circuit and the resistance R thrown in, as the lever *x* allows the lever Q to come in contact with the point *n*, the lever *x* breaking contact with it simultaneously. As this takes place the lamp cools and the contraction of *g* places the lamp in circuit again. Thus the resistance of the lamp and its appurtenances is quite regular regardless of the degree of temperate or amount of light the lamp is giving out. This feature of this light is similar to that shown in my application No. 166, and therefore does not form part of the present invention.

This apparatus is not a perfect regulator, as the resistance of the incandescent conductor increases with its heat; but if in any case it is desirable that the resistance should be practi-

cally constant at all temperatures the screw *n* may be arranged to operate contact-levers, so as to decrease or increase the resistance of R when it is thrown upward or downward, several bobbins of wires being used in R, as in my application No. 146, one or more being brought into circuit by the movement of the screw *n* and its levers. By the means above described about nine-tenths of the resistance, except of the main conductors, is light-giving resistance, thus effecting great economy in current.

As before described, as the connecting of one or more lamps causes a sufficient amount of current to be developed at the central station to keep the same incandescent, it follows that if the machines at the station are arranged expressly for tension and quantity many hundreds of lamps may be placed in circuit between the main conductors, the reduction of resistance upon placing each lamp in the circuit drawing the proper quantity of current from the station; hence the greatest economy possible is obtained by causing all the resistance outside of the main conductors to be light-giving resistances.

The lamp shown in Fig. 2 consists of a bobbin of wire insulated with a pyroinsulator, such as zircon, magnesia, lime, or other compounds of high fusibility, as set forth in my application No. 166. This bobbin B′, which has preferably a resistance of one thousand ohms, is placed within a metallic case, L, which is rendered highly incandescent by the radiated heat from the bobbin. The rod *g* is insulated from the case at P, and one end of the bobbin B′ is connected by a wire to this rod, the other end of the bobbin being connected to the case L or to the wire connected to the switch 2. When the lamp is turned off the lever Q is in contact with *n* and the resistance R is in circuit; but when *n* is lowered until the lever Q comes into contact with *x* the lamp is thrown in circuit and the regulating-rod *g* allows more or less intimate contact between *n* and Q.

I will mention that the case L is not necessarily metallic, as it may be of lime or zircon.

I claim as my invention—

1. The lamp consisting of a pyroinsulated coiled wire, in combination with a surrounding case that is rendered incandescent by the radiated heat, substantially as set forth.

2. The combination, with the electric lamp, of the thermal regulator, a resistance, and an adjusting device, *n*, arranged and operating substantially as set forth.

Signed by me this 28th day of January, A. D. 1879.

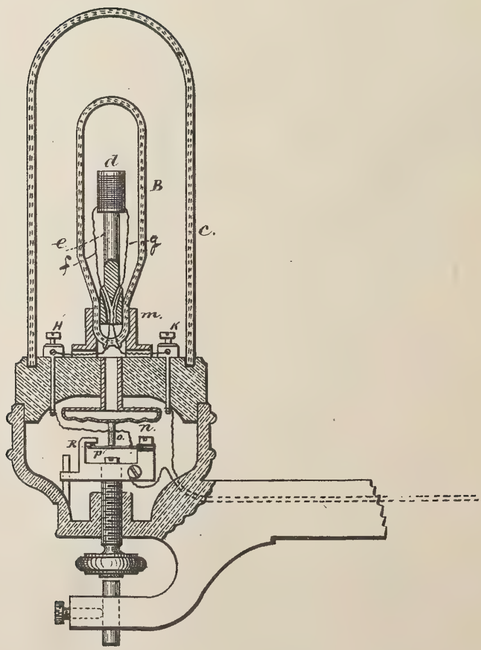
THOMAS A. EDISON.

Witnesses:

STOCKTON L. GRIFFIN,
J. N. MACKENZIE.

T. A. EDISON.
Electric-Lights.

No. 227,229. Patented May 4, 1880.



Witnesses

Chas. H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison.
per Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LIGHT.

SPECIFICATION forming part of Letters Patent No. 227,229, dated May 4, 1880.

Application filed April 21, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Electric Lights, (Case No. 176,) of which the following is a specification.

When platina and other metals that fuse at a high temperature are exposed to high heat and then cooled in the atmosphere they are injured, so that they are not well adapted to use in electric lights for a long period of time.

I inclose the conductor that forms the electric candle in a transparent case and heat the same gradually to expel any gases from the material of the candle. I form a vacuum in the transparent case and then seal the same hermetically, so that all injurious atmospheric influences are avoided.

The invention further consists of a vacuum-receptacle made entirely of glass and sealed by melting the same in combination with an incandescent continuous conductor pyro-insulated.

The invention further consists in winding pyro-insulated wire upon a bottom of a compressed infusible substance, such as lime.

The invention further consists in placing the vacuum-bulb within another glass receptacle, also closed from the air, and employing the expansion of the air between the two receptacles due to the heat of the incandescent bobbin to produce a movement which shall disconnect the lamps from the electric circuit when its temperature is too great.

The drawing shows a section of the apparatus, in which B is the transparent bulb. This bulb is open at the smaller end and the burner *d* inserted, and the open end of the tube is placed in connection with a mercury vacuum-pump, the platina wires *g* and *f* passing through. The burner is connected with a battery and variable-resistance coil while the vacuum is being made. The heat of the bobbin *d* is, in the course of one hour, brought gradually from the temperature of the air to vivid incandescence. When the vacuum is considered practically perfect the open end of the tube is melted and sealed. The platina wires passing through the glass are also sealed.

Thus I am enabled to obtain a nearly-perfect vacuum, which is permanent, and at the same time give the platinum wire a new and unknown property of great value in electric lighting, which is, that a platina wire which melts in the open air at a point where it emits a light equal to four candles will, when operated upon as described, emit a light equal to twenty-five candles without fusion. The reason why the melting-point of the metal is thus raised is, that in the act of making the vacuum with the metal under heat all the gases which are contained in its pores are withdrawn, and when the receptacle is sealed cannot re-enter when cold; hence unequal and sudden expansions cannot take place and the wire is never cracked, but if left uncovered becomes as bright as the most polished silver—an appearance which cannot be given it in any other way. On the other hand, it is known that the metals of the platinum group have, in a surprising degree, the peculiar power of absorbing within their pores many volumes of gas, and it is the sudden expansion of this gas upon a sudden accession of heat that disrupts the wire and produces cracks, which extend nearly to its center when the wire is brought to moderate incandescence in the open air. These cracks set up a great resistance to the passage of the current, and at these points become abnormally heated; hence the platina wire easily melts, whereas no such cracks are noticed when the wire has been operated upon in the vacuum and all its gases pumped out.

e is a cylinder, of lime, with a small spool on its extremity, on which the wire is coiled. About thirty feet of platinum or iridium wire coated with magnesia oxide is coiled upon the spool.

The wire may be of any size; but I prefer to use wire .005 of an inch in diameter, which will give a resistance when incandescent of about seven hundred and fifty ohms. By the use of such high-resistant lamps I am enabled to place a great number in multiple arc without bringing the total resistance of all the lamps to such a low point as to require a large main conductor; but, on the contrary, I am enabled to use a main conductor of very moderate dimensions.

Another important point is gained by the use of lamps of high resistance, as the resistance of the wires leading from the main conductors may be of very moderate dimensions; hence can be placed in the pipes already used for

gas, and at the same time effect a great saving in the cost of wire.

Still another point gained is, that the high resistance of the lamps allows all to be placed in multiple arc, which is the only method where the maximum economy is attainable, as the lamps, when connected to the circuit, draw from the central station just sufficient current to maintain it at the proper temperature, and if by accident or want of regularity in the main current the strength of the current should increase abnormally, the excess of heat sets the thermal regulator in motion and disconnects the lamp entirely from the circuit, thus stopping all further consumption of energy until the temperature of the lamp is reduced to its normal conditions. I will state that these changes are not perceptible to the eye; hence the lamp cannot consume any more energy than that required to cause it to emit a certain light.

No loss in economy occurs by using so large a resistance, because the loss of energy is proportionate to the radiating-surface exposed to the air and its temperature, and is independent of the resistance of the wire forming such surface.

m is a lime cup, into which the small end of the vacuum-burner is held. The platina wires pass under it to the binding-posts H K.

n is the thermal regulator, operated by the expansion of the air. When the temperature of the air between the bulbs becomes too great, the diaphragm bulges outward and the point *o* separates the spring *p* from R and disconnects the lamp from the circuit, where it remains until the temperature is reduced to the normal condition.

The spark upon the point is very small, as I employ constant field-magnets at the central station; hence the powerful sparks due to the secondary current set up by the weakening of the powerful field-magnet is avoided.

I will mention that the second globe *c* might be made entirely of glass, and the aneroid-diaphragm, provided with a platina tube, be sealed in the glass, or the aneroid itself be made of glass.

I am aware that an electric lamp has been made in which glass has been combined with other substances to form a case, and that efforts have been made to keep such case airtight; but the changes of temperature have prevented the maintenance of a vacuum or the exclusion of the atmosphere. In my improvement the chamber containing the light is made entirely of glass, and I am able to obtain and maintain a vacuum, because there is no substance joined to the glass; hence the entire chamber can be hermetically sealed and the conductors of metal passing through the glass and around which the glass is melted are so small as not to injure the glass by their expansion.

I am also aware that carbon has been heated in the presence of both liquid and gaseous materials for changing its character and adapting it to an electric light. In my present invention the gaseous materials contained in metallic wire are driven off by the action of heat evolved by an electric current while the wire is in a vacuum, so that the pores of the metal are not filled with any extraneous substance; but, on the contrary, the metal is solidified by the removal of extraneous matter and the pores closed.

In my application No. 166 I have set forth an electric lamp formed of pyro-insulated metal. I do not, therefore, claim the same herein.

I claim as my invention—

1. In an electric lamp, the combination, with a hermetically-sealed vacuum-chamber made entirely of glass, of metallic conductors passing through the glass and around which the glass is melted, and an incandescent conductor placed in the electric circuit, substantially as set forth.

2. The method herein specified of treating metallic conductors for electric lamps, consisting in inclosing the conductor in a glass case, exhausting the atmosphere from such case, heating the conductor by an electric current, and then hermetically sealing such glass case, substantially as set forth.

3. The combination, in an electric lamp, of a hermetically-sealed vacuum-case made entirely of glass, conducting-wires passing through the glass and around which the glass is melted, and an incandescent body formed of a pyro-insulated wire and an infusible core for the same, substantially as set forth.

4. The combination of a transparent vacuum-case, a continuous conductor forming an electric candle, and a second transparent case forming a closed chamber, for the purpose set forth.

5. The combination of the conductor *d*, forming an electric candle, the transparent sealed case B, the transparent case *c*, inclosing the case B, and the thermostatic regulator *n o p* R, substantially as set forth.

Signed by me this 12th day of April, A. D. 1879.

THOMAS A. EDISON.

Witnesses:
S. L. Griffin,
Edwin M. Fox.

2 Sheets—Sheet 1.

T. A. EDISON.
Phonograph.

No. 227,679. **Patented May 18, 1880.**

Fig. 1.

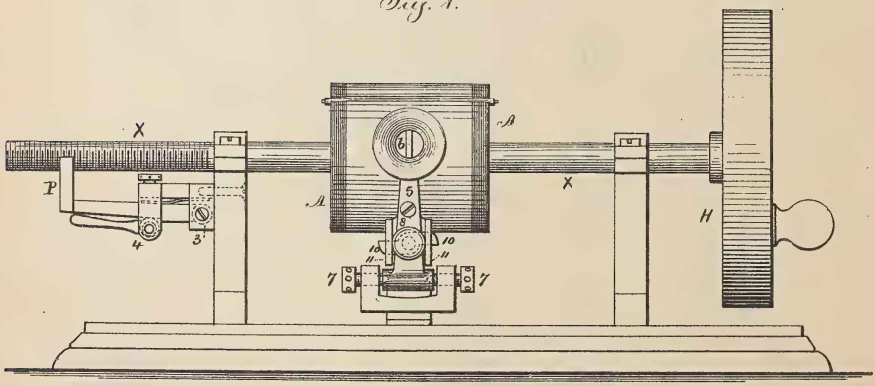


Fig. 2.

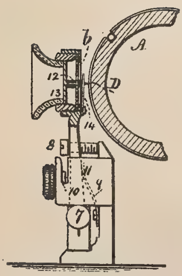


Fig. 5.

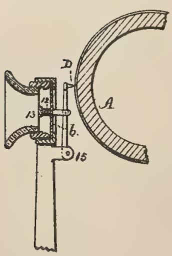
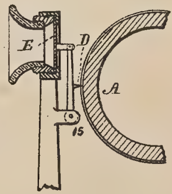


Fig. 6



Witnesses.

Harold Serrell

Chas H Smith

Inventor

Thomas A. Edison

per Lemuel W. Serrell

atty.

2 Sheets—Sheet 2.

T. A. EDISON.
Phonograph.

No. 227,679. **Patented May 18, 1880.**

Fig. 4.

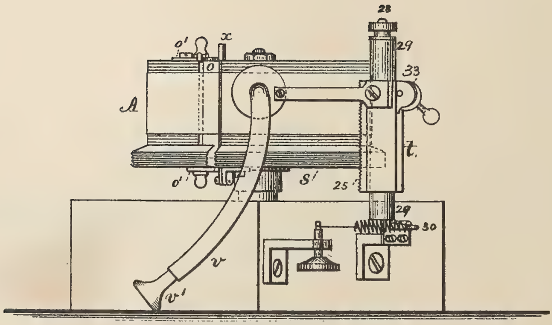


Fig. 7.

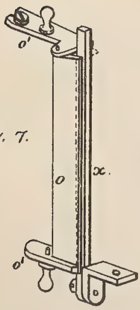
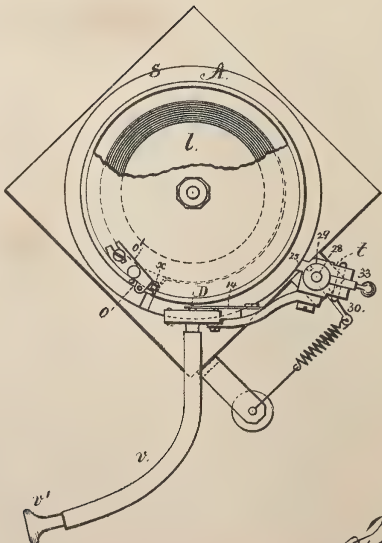


Fig. 3.



Witnesses.
Harold Serrell
Chas H. Smith

Inventor.
Thomas A. Edison
per Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

PHONOGRAPH.

SPECIFICATION forming part of Letters Patent No. 227,679, dated May 18, 1880.

Application filed March 29, 1879.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Phonographs, (Case No. 174,) of which the following is a specification.

In Letters Patent No. 200,521, granted to me, a cylinder with a helical-grooved surface is revolved with its screw-shaft and moved along endwise. Upon this cylinder there is a sheet of foil or similar material, and the same is indented by the action of a point moved by a diaphragm, and this foil forms a phonogram that can be used to reproduce the original sounds when moved in contact with a point and diaphragm. In the said patent one of the points is shown as connected directly to the diaphragm, and the other point is upon a spring.

My present invention relates to improvements upon the phonograph patented as aforesaid, and the features of such improvement are hereinafter specially pointed out.

In the drawings, Figure 1 is an elevation of the phonograph. Fig. 2 is a section of the diaphragm. Fig. 3 is an end view of the cylinder containing the foil. Fig. 4 is a side view of the diaphragm and the device for moving the same.

The cylinder A has a grooved surface, as in aforesaid patent, and it receives the tin-foil or other material that is to be indented by the action of the diaphragm *b* and point to produce the record of the sound, which I term the "phonogram," and the diaphragm E and point D are adapted to form a phonet and reproduce the sound; but it is to be understood that the same point and diaphragm may be employed to record and to reproduce the sound.

In my present invention, as in my former patent, the motion of the recording-surface may be derived from clock-work, hand, or other power.

In order to insure great uniformity of speed and prevent irregularity in the movement by inaccuracies of work, dust, lack of oil, or any other source of local friction or resistance, I make use of an abnormally heavy fly-wheel, H, upon the shaft of the phonograph, so as to prevent any trembling movement and to resist any tendency to increase or lessen the speed, for upon uniformity of speed of the phonet with the phonograph depends the accuracy of reproduction, especially in musical sounds, that depend for their tone upon the number of vibrations per second.

The nut P is upon a lever pivoted at 3 and kept in contact by a cam, 4. When this lever and nut P are lowered the shaft X and cylinder A can be slipped endwise.

The arm 5, carrying the diaphragm *b*, should be pivoted at 7 7 by pointed screws, so as to adjust the position of the recording-point of the diaphragm *b* relatively to the grooves of the cylinder. The screw 8 determines the position to which the diaphragm and recording-point may approach to the cylinder. The spring 9 serves to move the arm 5 away from the cylinder, and the double-ended locking-piece 10, entering slots in the frame 11, holds the arm in place when in use.

One of the peculiarities of the present invention over the aforesaid patent is a spring, 12, of india-rubber or other suitable material, placed between the cross-bar or bridge 13 and the diaphragm, that serves as a damper to prevent false vibrations of the diaphragm and cause it to respond only to the actual movement given by the phonogram through the point D. It is also usually preferable to employ a spring, 14, between the point and the diaphragm. This is useful, in both the phonograph and the phonet, to prevent false sounds. This spring and diaphragm I have used in connection with telephones. I do not, therefore, herein lay claim to the same, broadly. I have combined the same with the recording or phonet point and the phonogram.

Another feature of invention relates to a lever between the diaphragm and the phonogram, whereby the relative movements of the parts may be varied. This lever *e* has a fulcrum at 15. If the connection to the diaphragm is between the point D and fulcrum 15, as in Fig. 5, then the motion of the point will be greater than the diaphragm, and when used in the phonograph will amplify the indentations

in the foil. If used in the phonet, the movement of the diaphragm would be lessened. I therefore prefer, in that instrument, to change the places of the point and diaphragm connection, as shown in Fig. 6, so as to amplify the movement of the diaphragm and increase the sound.

Another feature of my present invention relates to the foil-holder, which I place on a reel within the cylinder A, and draw the same out through a slot, as required from time to time, thus preserving the foil from injury and rendering it unnecessary to handle the same.

The reel *l* within the cylinder A is adapted to receive the foil in a roll upon it. One head of the cylinder is removable, so as to allow of the insertion or withdrawal of the reel. There is a slot in the cylinder, through which the foil is brought out, and there is a bar, *o*, forming part of the periphery of the cylinder, that is connected at its ends to the slides *o'*, (see Fig. 7,) one at each end of the cylinder, and there is a lever-bar, *x*, behind this slide-bar *o*. When the slide *o'* is drawn back from over the lever *x*, such lever can be swung out of the slot in the cylinder A, and the foil can be drawn out of the slot and wrapped around the cylinder, and then the end is placed behind the bar *x*, and carried by it into the slot of the cylinder, and then the slide *o'* is moved so that its edge passes over the lever *x*, and in so doing the foil is tightened around the cylinder and the lever *x* held in place. The surface of this cylinder is made with a helical groove, and the rim *s* of the cylinder is made with a similar screw or groove, and the sliding sleeve *t*, that carries the diaphragm-arm, has a screw-surface at 25, that comes into contact with the screw *s*.

With this character of instrument it is preferable to have the cylinder A upon a vertical shaft, and the sleeve *t* and diaphragm will be moved vertically. For this purpose the fixed stud 28 is vertical, and upon it is a tube, 29, of a size to receive the sleeve *t*, and having a groove and key, by which the sleeve *t* is allowed to slide endwise of the tube 29; but the two can be turned together on the stud or shaft 28. An arm, 30, on the tube 29, and a spring, serve to turn the tube, the sleeve, and the diaphragm and arm with sufficient force to bring the point D to bear upon the foil with the required force.

It is preferable to employ with the diaphragm a tube, *v*, and mouth-piece *v'*, such tube being flexible.

The speaking into and recording of the sounds in the phonograph will be proceeded with as usual, and the reproduction of the sounds will be as before; but in case the operator wants to suspend the recording in the phonograph or the speaking in the phonet he simply has to draw upon the flexible tube, which swings the parts so as to disconnect the screw-rack from the flange *s* of the cylinder. This at the same time moves away the recording or the phonet point. The cylinder A can continue to revolve, and when the operator is ready he releases the pull upon the flexible tube, and the parts commence to act again at the exact place where the operation was suspended, because the screw-threads will only drop together when the proper part of the thread *s* comes to the corresponding part on the rack 25.

I employ the cam 33 and its lever upon the sleeve *t* to act upon the tube 29 and prevent the sleeve falling when the screw-threads are disconnected. This cam-lever 33 is self-acting, and it has to be raised when the sleeve *t* is to be lowered, so as to recommence at one end of the cylinder A.

By simply turning the sleeve and moving the diaphragm and the screw-surface back, the sleeve and diaphragm can be slipped endwise to any desired place upon the cylinder A to receive or deliver sounds.

I am aware that fly-wheels are employed in numerous ways for equalizing the speed of machinery. I do not claim the same, broadly. In experimenting with my phonograph I discovered that the reproduction of the sound was imperfect if the slightest variation occurred in the speed; hence the combination with the cylinder of a very heavy fly-wheel in proportion to the cylinder rendered perfect and reliable the action of the instrument in receiving and reproducing the sound by equalizing the speed.

I claim as my invention—

1. The combination, with the phonograph cylinder, shaft, and screw-surface, of a swinging nut or screw-surface, to connect or disconnect the parts that keep the recording or phonet point in position relative to the groove of the cylinder, substantially as set forth.

2. In combination with foil or a sound-recording surface, a point, a diaphragm, and a spring or damper acting to press the diaphragm toward the point, substantially as set forth.

3. In combination with a foil or sound-recording surface, a point, a diaphragm, and a spring between the point and the diaphragm, substantially as set forth.

4. The combination, in a phonograph or phonet, of a diaphragm, a point, and a lever intervening between the diaphragm and the point, substantially as set forth.

5. The combination, with the spirally-grooved cylinder in a phonograph, of a reel within the cylinder carrying the foil or similar recording material, a slot in the cylinder, through which the foil is led out, and means for clamping the foil, substantially as set forth.

6. The combination, with the cylinder A, of the sliding bar *o* and lever *x*, to clamp the foil and stretch the same, substantially as set forth.

7. The swinging sleeve *t*, having an arm that carries the diaphragm, in combination with the cylinder A, and rim *s*, having a screw-thread surface, substantially as set forth.

8. The tube 29 upon the fixed stud 28, in combination with the sliding sleeve *t*, the diaphragm, and the cylinder A, substantially as described and shown.

Signed by me this 19th day of March, 1879.

THOMAS A. EDISON.

Witnesses:

S. L. GRIFFIN,

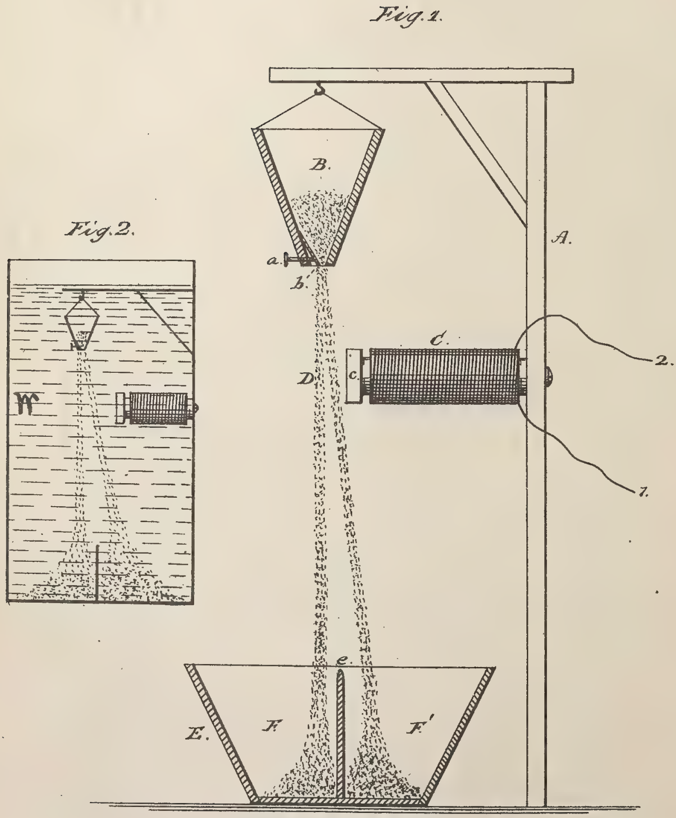
WM. CARMAN.

(No Model.)

T. A. EDISON.

Magnetic Ore-Separator.

No. 228,329. Patented June 1, 1880.



Attest:

F. W. Howard

F. C. Neall

Inventor:

Thomas A. Edison

by Dyer & Wilber

Attys

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MAGNETIC ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 228,329, dated June 1, 1880.

Application filed April 7, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Magnetic Separation of Substances; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to furnish means which, while simple and cheap in construction, shall economically and effectually separate magnetic from non-magnetic substances. To this end I so arrange a hopper for feeding the mingled magnetic and non-magnetic substances, a magnet, and receptacle for the substances, in such relation to each other that the trajectory of falling magnetic substances is altered, the magnetic and non-magnetic substances falling into different receptacles.

A suitable method of carrying this invention into effect is as follows: A hopper, preferably provided with an adjustable valve-orifice, and arranged to feed the mingled substances in a thin broad stream, is supported in any suitable way several feet (more or less) above a bin, which is partly immediately under the feeding-orifice of the hopper, so that material falling from the hopper would, under normal conditions, fall therein. Between the hopper and the bin, and to one side of the straight line connecting the two, is a magnet having a polar extension whose face is of a length equal to the width of the feeding-orifice of the hopper. Underneath the magnet, and by the side of the bin before mentioned, is another bin for the reception of the magnetic substances. Instead of these two bins, one bin, with a partition nearly or quite underneath the pole of the magnet, may be used, or a simple partition may be similarly placed upon a floor and the bin or bins entirely dispensed with.

The material fed from the hopper tends to fall in a straight line. As it comes, however, within the influence of the magnet the magnetic portions are attracted thereby and move toward the magnet, which is so placed with relation to the falling material that it cannot be attracted entirely to the magnet before gravity has carried it past. In other words, the trajectory of the falling magnetic substance is altered, it moving for a portion of its fall in a line which is the resultant of the two forces—gravity and magnetism—acting upon it.

In the drawings, Figure 1 represents, partly in elevation, partly in section, a simple apparatus for carrying my invention into effect. Fig. 2 shows the apparatus submerged in water.

To any suitable support or frame-work A is attached a hopper, B, provided with a flap-valve, *b*, adjusted by screw *a*, for regulating the thickness of the sheet of issuing material. A magnet, C, is supported below the hopper B in any suitable way. This magnet is provided with an extended polar face, *c*, of a length equal to the width of the feeding-orifice of the hopper. The polar face *c* is to one side of the line which the material would assume by force of gravity in falling from the hopper. This magnet C is connected by wires 1 2 to a battery, generator, or any suitable source of electricity.

Beneath the hopper and magnet is placed a bin or receptacle, E, having a partition, *e*, dividing it into two parts, the bin being so placed that the partition is nearly beneath the pole *c*—that is, so placed that if continued upwardly it would pass between the pole and the feeding-orifice of the hopper. Instead of a bin or bins being used, this partition *e* may be placed directly upon the floor.

Supposing now the hopper B to be filled with material, partly magnetic, partly non-magnetic, the material in falling would by force of gravity fall as shown at F. The magnetic portions, however, are attracted toward the magnet C; but before they are brought over out of their path sufficiently to touch and cling to the pole *c* gravity has carried them past, and they fall as shown at F′.

Instead of a magnet or magnets on one side, a magnet or magnets on both sides of the falling stream of material may be used, in which case the non-magnetic particles would fall in the center, the magnetic particles being drawn to one side or the other.

Instead of electro-magnets, it is evident that, if desired, permanent magnets may be used.

When the material is wet it may first be

dried; or the entire apparatus may be placed in a tank of water, as I have found that when wet, heavy sand is used the tendency to clog in the hopper and to cling together in falling is entirely overcome by placing the hopper and magnet in water, as shown in Fig. 2; or the hopper alone may be placed in a tank of water and the magnet entirely upon the outside thereof, or the body upon the outside, with its polar face extending through the side of the tank.

While the drawings show the substance falling in a straight line, it is evident that the principle of this invention could be carried into effect in other ways. For instance, the material to be treated may be first impelled by a blast of air or by other means in a horizontal plane, and the magnet placed above or below the line of the normal trajectory of the material, so as to lengthen or shorten the trajectory of the magnetic substance.

When desired the material to be acted on may be fed through the magnetic field in a column of water, the water acting to keep the particles apart, preventing them clinging together by capillarity. The magnet in such case draws the magnetic particles out of the column of water, or out of the center thereof, which may be pumped back and used over and over.

What I claim is—

1. The method of separating magnetic and non-magnetic substances, which consists in allowing them to fall together, and then by magnetic attraction altering or changing the trajectory of the falling magnetic substance without stopping its fall, substantially as set forth.

2. The combination of a hopper, a magnet, and a dividing partition, when arranged relatively to each other, as hereinbefore set forth.

3. The combination of a hopper and a magnet, arranged relatively to each other, as hereinbefore described, and submerged in water, substantially as set forth.

This specification signed and witnessed this 3d day of April, 1880.

THOMAS A. EDISON.

Witnesses:
WM. CARMAN,
GEO. E. CARMAN.

(No Model.)

T. A. EDISON.

Brake for Electro-Magnetic Motors

No. 228,617. **Patented June 8, 1880.**

Fig. 1.

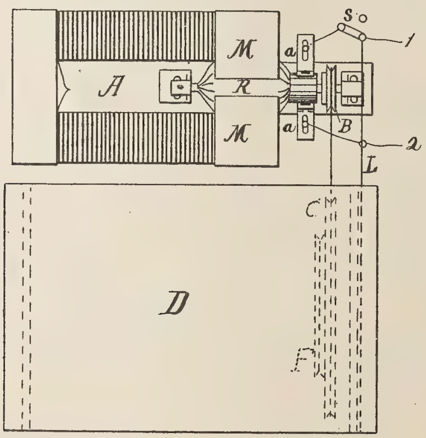


Fig. 2.

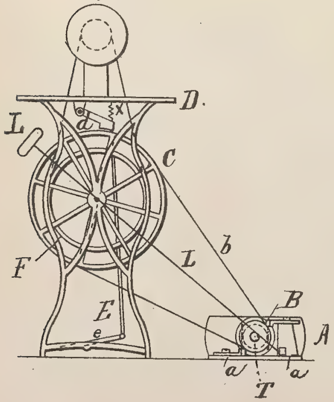
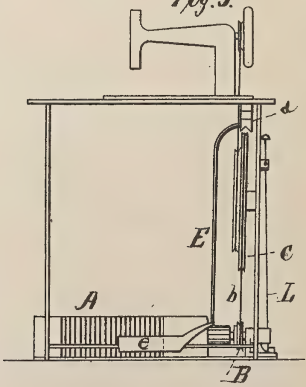


Fig. 3.



Attest:

Saml. D Mott

John C. Schroeder.

Inventor:

T. A. Edison

per Dyer & Wilber

Att'ys

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

BRAKE FOR ELECTRO-MAGNETIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 228,617, dated June 8, 1880.

Application filed March 20, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electro-Motors, (Case No. 207;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In using electro-motors, especially for actuating light machinery, it is very desirable that the rate of speed of the actuated machine be under control of the operator, and that the means of control be simple, effectual, and easy of application. Hitherto this has been attempted only through controlling the electric circuit to the motor, breaking or closing it in whole or in part. This breaking of the circuit is destructive of the contact-points, and ordinarily effects only starting and stopping of the machine, and does not regulate the speed of the machine while running. I propose to control the speed of the driven machine without affecting the motor by the means more fully hereinafter described and claimed.

In the drawings, Figure 1 is a plan view of an electric motor and stand for a machine to be actuated thereby. Fig. 2 is an end view of the same, and Fig. 3 a front view.

A is any suitable electro-motor, in which R is the rotating armature, on whose shaft is a commutator, upon which press the springs or brushes *a a*, for completing the circuit from the conductors 1 2 to the motor.

Upon the shaft T is the pulley B, secured thereto by friction, the friction being so adjusted that the pulley and shaft shall be held and move together when only the resistance of the actuated machine is to be overcome, but that whenever a greater resistance is offered the friction shall be overcome and the shaft rotate within the pulley without rotating it.

From the pulley B a belt, *b*, leads to the large fly-pulley C, secured to the frame of the actuated machine. Upon the shaft of C is the pulley F, from which a belt transmits the motion to the actuated machine.

Upon the under side of the table D, or to any convenient part of the frame, is pivoted a brake, *d*, adapted to be brought to bear upon the pulley C, but held normally from so doing by a spring, *x*. To the brake *d* is pivoted the lever E, which passes down and is connected with a treadle, *e*, underneath the table. Through this treadle, then, any desired pressure may be put upon the periphery of the wheel C, regulating its speed, the current to the motor remaining unaffected and its rotation continued.

A switch, *s*, is used for breaking or closing the circuit to the motor. To the switch is attached a lever, L, which passes to the front of the machine, within easy reach of the operator. The current passes by wire 1 across the switch *s* when closed, as shown, through the motor, and out by wire 2, or vice versa. This switch may, if desired, be placed upon the frame or table of the actuated machine.

The form of brake used may be varied. For instance, it may be a belt-tightener, the belt *b* being normally loose, and the brake arranged to tighten it, so that it will take upon the pulleys and transmit motion from one to the other.

What I claim is—

1. The combination, with an electro-motor, of a mechanical brake, adapted to control the speed of the actuated machine, connected to the motor through a pulley fastened to the shaft of the motor by friction, substantially as set forth.

2. The combination, with an electro-motor, of a brake applied to the main driven wheel and controlling the speed of such wheel, but not that of the motor, substantially as set forth.

3. The combination, with an electro-motor, of a friction-pulley on the rotating shaft of the motor and a brake applied to the main driven wheel and adapted to control its speed, substantially as set forth.

This specification signed and witnessed this 10th day of March, 1880.

THOMAS A. EDISON.

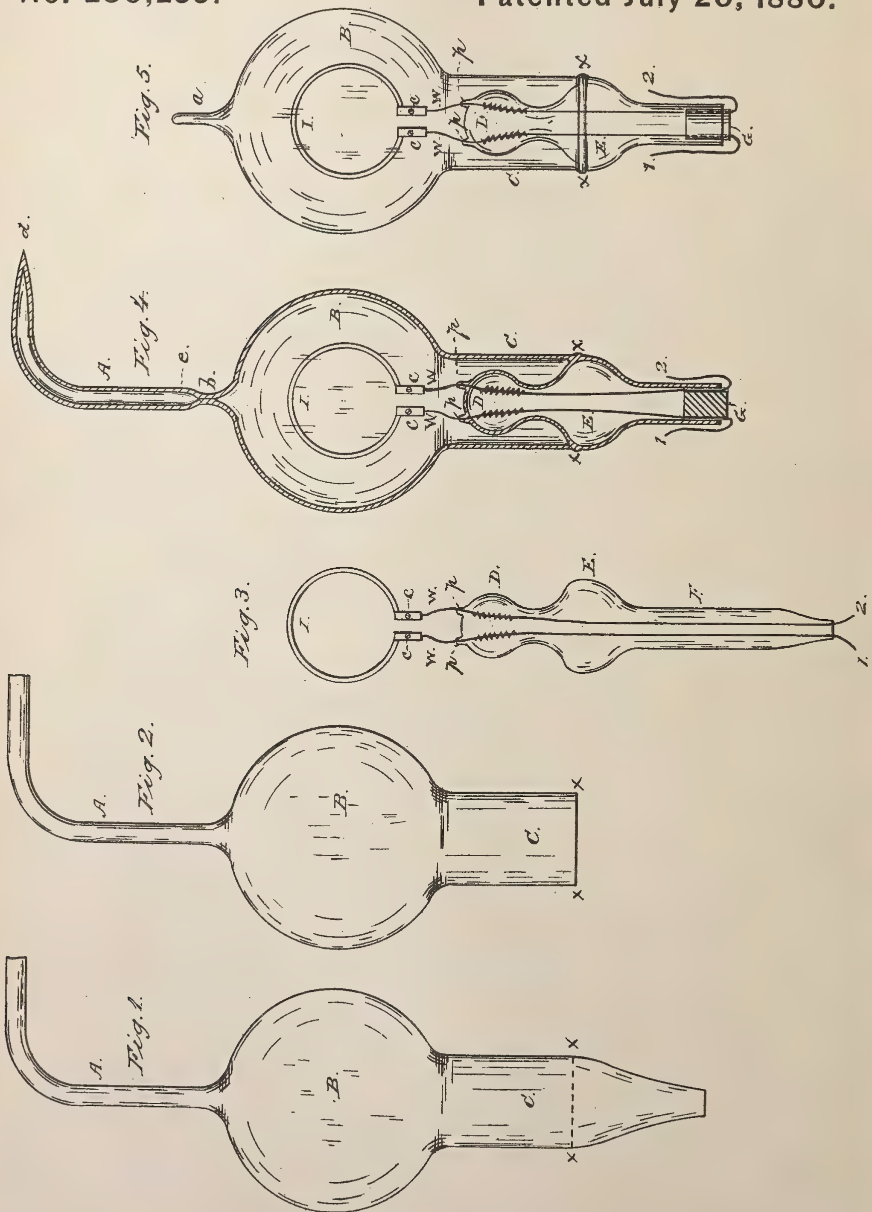
Witnesses:

WM. CARMAN,

C. P. MOTT.

T. A. EDISON.
Method of Manufacturing Electric Lamps.

No. 230,255. **Patented July 20, 1880.**



Attest:
James A. Payne.
John C. Schroeder

Inventor:
T. A. Edison
per Dyer & Wilber
his Atty's.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

METHOD OF MANUFACTURING ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 230,255, dated July 20, 1880.

Application filed February 5, 1880.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, resident at Menlo Park, State of New Jersey, have made certain new and useful Improvements in Electric Lamps and the Method of Manufacturing them, of which the following is a specification.

My electric lamp consists, essentially, (as shown in prior applications of mine for patents,) of an incandescing conductor of high resistance hermetically sealed in a glass vacuum-chamber.

Great difficulty has always been experienced in so sealing a glass vacuum globe or chamber that complete union of the parts was had and danger of opening or separation avoided, in order that a stable vacuum might be maintained when the parts forming the seals were *in vacuo* when the sealing was done. In fact, the maintenance of a stable vacuum has been pronounced impossible by many scientists.

The object of my invention is to furnish a method of manufacturing electric lamps so that a stable vacuum may be maintained therein.

In carrying out my method of manufacture, a glass bulb, of the size desired for the inclosing-globe of the lamp, is formed with a supporting-neck extending in one direction, of a diameter sufficient to permit the passage of the incandescing conductor through it. Preferably a piece of tubing, of the size of the neck, has the bulb blown in it. Upon a point on the bulb, preferably exactly opposite the center of the neck, is formed a long tube for attachment of the bulb to the air-exhausting apparatus.

Upon the end of a smaller piece of tubing a small bulb is formed, and the body of the tube, a little below the bulb, is enlarged for a small space to about the size of the supporting-neck. This portion forms the arc-supporting part, wires, terminating in clamps for holding the conductor, being passed therethrough and hermetically sealed therein. After the conductor has been secured on the supporting portion it is passed up through the neck of and into the bulb until the farther passage of the supporting portion is stopped by the enlargement thereon taking against the end of the neck of the bulb, when the two are sealed together at that point by fusion.

The mechanical construction of the lamp being now complete, it is attached, by the neck before mentioned, to the air-exhausting pump. When a proper vacuum has been attained the end of the tube is softened and sealed, after which the lamp is removed from the pump. The tube is then softened and sealed near its point of juncture with the globe, as the neck was before sealed at the tip. There is the same degree of vacuum upon both sides of this last seal—*i. e.*, within the globe and in the tube between it and the tip. The vacuum in the neck is then destroyed by fracture of the neck, and the neck is again softened and sealed immediately above the seal which was formed at the juncture of the tube and globe, and the surplus portion of the tube removed.

For a more particular description reference is to be had to the drawings accompanying and forming part of this specification, in which—

Figure 1 is a view of the globe, the neck, and tube as first formed. Fig. 2 is a view of the same ready to receive the incandescent conductor and its support. Fig. 3 is a view of the incandescent conductor and its support ready for union with the globe. Fig. 4 is a sectional view of the parts of the lamp joined together and sealed; and Fig. 5 is a view of the completed lamp.

A piece of tubing, the size of C, is taken, on which is blown or otherwise formed the bulb B, whose upper portion is drawn out into the tube A, curved so that several bulbs may be attached to one air-exhausting pump.

The part C is left unchanged in order to form a supporting-neck for the lamp. In forming this tubing, however, the lower end is often drawn out, as shown in Fig. 1. This small end is removed on the line *x x*, leaving the globe, neck, and tube as shown in Fig. 2.

F is a piece of glass tubing, of a size somewhat less than C. Upon its upper end is formed the bulb D, on whose top are drawn out the two wire seals *p p*. Below D the enlargement E is formed in the tube F, its exterior diameter being the same as that of C. Platinum wires *w w*, joined to conductors 1 2, are passed through openings in the projections *p p*, which are then fused by heat around the

wires *w w*, so as to seal the wires hermetically in the glass by seals extending around the wire above the general surface of the bulb D, as clearly shown in the drawings. Clamps *c c* are then attached to the wires, and the incandescing conductor fastened in the clamps.

It is to be here remarked that the clamps or wires within the globe must be of some material not so affected by any influences existing within the globe, where the proper vacuum has been attained, as to interfere with the light or its proper dissemination. If iron be used, it is so acted on that it is gradually destroyed, with an ensuing deposit on the glass, obscuring the transparency of the globe, and also acting on the carbon, uniting with it, and finally destroying it. In order to prevent this and to guard against any injurious influences whatever, the clamps *c c* and wires within the globe should be of platinum or some metal or metals of the platinum group, treated by the process described by me in an application for a patent now pending.

The arc I and bulb D are inserted in the neck C until the end *x x* of the neck C rests upon the enlargement E, when the two are securely and hermetically there joined by fusion of the glass at that point. The lamp is then attached, by the tube A, to an exhaust-pump. When the proper degree of exhaustion has been reached the tube A is sealed by fusion of glass at *d* and removed from the pump, whereupon a seal, *b*, is made in the tube A, immediately above the globe B. This last sealing is made entirely *in vacuo*, and the degree of vacuum in B and in A, between *b* and *d*, is the same. I have found, however, that a perfect seal cannot be made when all the portions of the glass which unite to form the seal were in a vacuum when the seal was made. Hence the seal *d* of the tube A is now broken off, admitting air in A above *b*. A is now sealed by fusion at *e*, or A may be broken off at *e*, and a drop of molten glass placed thereon to form the seal. The seal *a*, Fig. 5, is now the resultant of two sealings—one at *b in vacuo* and one at *e* in air.

I have found that such a seal is lasting under all conditions, and that by the method here indicated a globe is so constructed and sealed that a vacuum perfectly stable is maintained therein.

The wires 1 2, for attachment to devices for completing the circuit, pass out of the end of the tube F, in order to prevent their accidental crossing or displacement. A plug, G, of cork, plaster-of-paris, or other insulating material, is put in the end of F, securing the wires therein.

What I claim is—

1. The method of forming electric lamps, substantially as set forth, consisting in separately forming the inclosing-globe and the supporting-bulb for the incandescent conductor, attaching the wires and incandescent conductor thereto, and then hermetically uniting the parts prior to the formation of the vacuum, substantially as herein described.

2. The method of hermetically sealing a vacuum-chamber, substantially as described, which consists in first sealing *in vacuo* and then sealing in air, substantially as described.

In testimony whereof I have hereunto affixed my signature this 28th day of January, A. D. 1880.

THOS. A. EDISON.

Witnesses:
C. P. MOTT,
S. D. MOTT.

T. A. EDISON.
Addressing Machine.

No. 230,621. Patented Aug. 3, 1880.

Fig. 1.

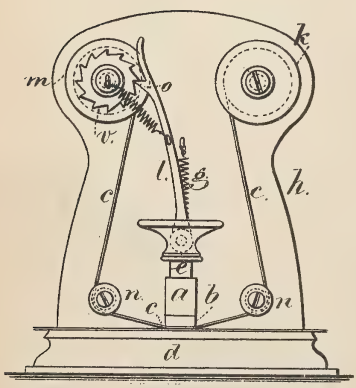
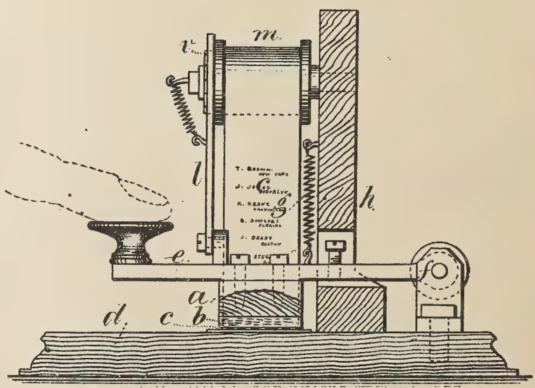


Fig. 2.



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thos A. Edison
per Lemuel W. Serrell
att'y.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ADDRESSING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 230,621, dated August 3, 1880.

Application filed May 10, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Addressing-Machines, (Case No. 137,) of which the following is a specification.

This invention is made for addressing newspapers or newspaper-slips, or for canceling or numbering in succession; and it consists in the combination, with a strip of paper perforated with numerous holes to form the letters or numbers, of an ink-pad containing a limpid ink and a presser, whereby the ink is forced through the holes in the paper, and in combination therewith I employ a lever and an automatic device for moving a ribbon-paper along progressively.

In the drawings, Figure 1 is an elevation, and Fig. 2 is a vertical section, of the improvement.

The presser *a* has upon its surface a pad, *b*, containing a limpid ink—such, for instance, as that described in my Patent No. 180,857—and this may be supplied from time to time or by a fountain.

The stencil is of paper, and instead of the ink passing through the pores of the paper, or through holes made by cutting out portions of the material, I employ a piece of paper having punctures or needle-holes made through the same where the ink is to mark, so that the paper is not weakened, and hence I am able to move it along so as to give one impression after another. The fabric of the paper should be ink-proof, or nearly so, in order that it may not absorb the ink and become useless by the ink hardening, as is the case where the paper itself is of a porous character, and this stencil-paper is below the inking-pad, so that when the article to be marked is laid upon the bed *d* and pressed the ink will pass through the stencil and mark the said article. The lever *e* upon the fulcrum *f* is a convenient means for holding the presser *a* and giving the impression. A spring, *g*, is adapted to raise the said lever, and a guide-plate, *h*, is shown with a slot for the lever to pass through.

The perforated or stencil paper or material *c* is shown as a ribbon, and this is wound upon the roller or drum *k*, passes through guides *n*, and is drawn off progressively and moved along by the rotation of the roller *m*, upon which the paper is wound.

The pawl *o*, extending from the lever *l* to the ratchet-wheel *v*, is shown as a convenient means for moving the paper along; but this may be varied to suit the length or character of the ribbon.

I am aware that paper has been employed that is of a porous texture or that has been rendered porous by chemical action, as in Letters Patent No. 171,780.

I am also aware that paper has been perforated for producing patterns, as in Letters Patent No. 55,869.

I am also aware that stencils have been cut out and ink forced through the openings, as in Letters Patent No. 17,340.

In Letters Patent No. 186,733 a device similar to the present is set forth; but priority of invention was decided in my favor.

I claim as my invention.

A stencil made of paper that is punctured with small holes where the ink is to pass, in combination with a pad containing limpid ink, a presser behind that pad, a surface or bed for the material to be printed, and means, substantially as described, for moving the stencil along progressively, as set forth.

Signed by me this 8th day of May, 1877.

THOS. A. EDISON.

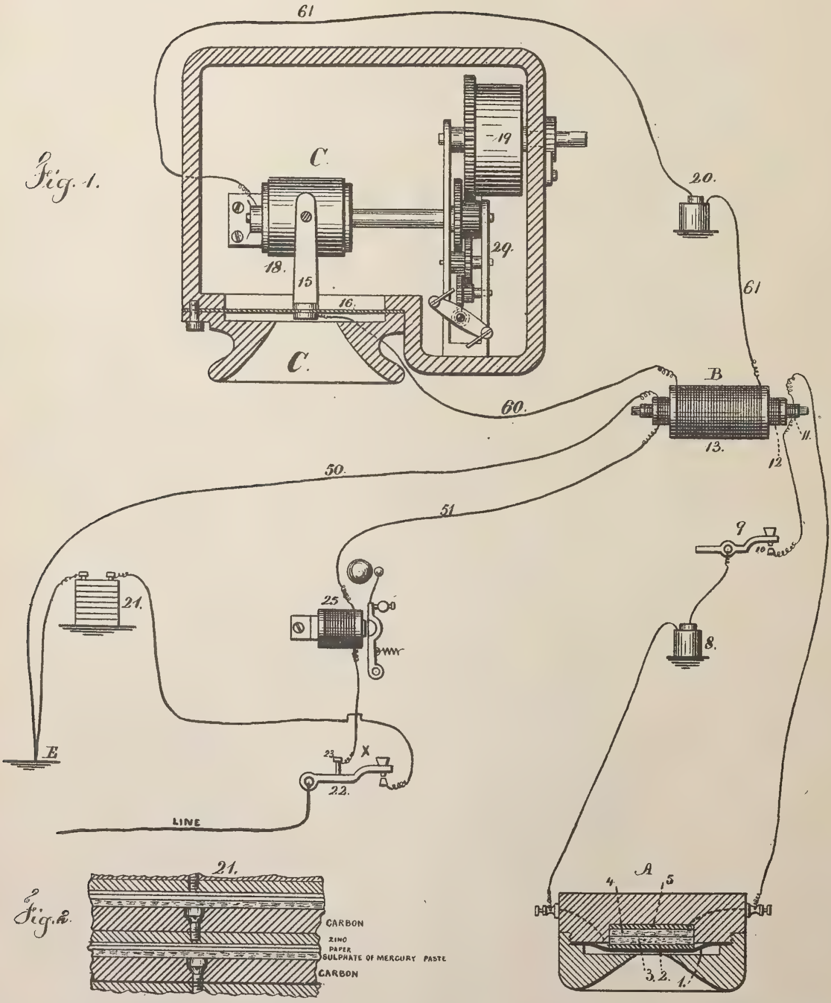
Witnesses:

GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.

Electro Chemical Receiving Telephone.

No. 231,704. Patented Aug. 31, 1880.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRO-CHEMICAL RECEIVING-TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 231,704, dated August 31, 1880.

Application filed July 25, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented a new and useful Improvement in Telephones, of which the following is a specification. (Case No. 181.)

The object of this invention is to transmit and reproduce over telegraph-wires speech or other sounds telephonically.

The invention relates to an improved electro-chemical receiving-instrument and the method of working such receiving-instrument by placing the same in a tertiary circuit and translating the electric waves which serve to operate it by induction.

In the drawings, Figure 1 represents the apparatus and circuit-connections at one end of the line, and Fig. 2 is a section of the call-bell battery.

A is the transmitter, which consists of two buttons, 3 and 4, made of finely-divided conducting material, such as carbon, and facing and resting at all times upon each other. 2 and 5 are metallic plates which are permanently secured to these two buttons and serve to connect the conducting-wires to the buttons. These are placed in a recess in an ordinary telephone-case, and a piece of rubber-cloth, 1, serves to keep the buttons in position and keep the moisture from them.

The principle of operation is the same as in my previous applications, in which sound-waves are translated into electrical waves, the device here shown being merely a modification thereof.

This transmitter is connected, in the circuit containing the battery 8 and key 9, with a circuit-closing point, 10, and primary coil of the inductorium B. The key 9 serves to close the circuit in the act of transmitting and to open it when receiving.

11 is the primary coil. 12 is the secondary coil, which is included in the main circuit by wires 50 and 51.

The wire 50 proceeds to the earth E, while 51 passes through the call-bell magnet 25 to point 23, key-lever 22, and to the line. Hence any waves thrown into the secondary wire upon B pass to the distant station.

13 is the tertiary coil. In the circuit of the tertiary coil is the electro-chemical receiver C. The wire 60 passes to the arm 15 of the diaphragm 16, the end of which arm rests upon the moistened cylinder 18.

The cylinder 18 is revolved continuously by means of a spring within the barrel 19 giving motion to the train of gearing at 29. The wire 61 returns to the other end of the tertiary coil.

20 is a battery which serves to keep a constant current in tertiary circuit.

The porous or chalk cylinder is kept moist by an electrolytic solution, such as water or acidulated water, and that part of the arm 15 which rests upon the chalk is tipped either with platina or palladium. I have found by experiment that when the arm is tipped with palladium the battery 20 is not required in the circuit 61 to the tertiary coil 13, but when platinum is used the battery appears to be necessary to obtain the best results.

The operation of the electro-chemical receiver is the same as in my application No. 175, except that the cylinder and arm are placed in a tertiary circuit instead of being placed direct upon the line. The object of placing it in a tertiary circuit is to keep the apparatus free from earth-currents, which cause alterations in the volume of sound, owing to the marvelous delicacy of the apparatus.

The key x serves to put the call-battery 21 in circuit and disconnect the bell-magnet 25 and primary 12 from the circuit when calling the distant station.

The battery 21 consists of a cell containing fifteen Marie Davy batteries, formed of disks of carbon and zinc fastened together by screws, as in Fig. 2. After being fastened together they are boiled in paraffine, and the surface of the zinc and carbon scraped. Fourteen of these double disks are used. At the bottom of the cell there is laid a disk of carbon; on this is laid a layer of sulphate of mercury paste; on this two sheets of moistened paper; on this is laid a double disk with the zinc side down; on the carbon side another layer of the mercurial salt is laid, and the same order of laying continued until the cell is finished. These are then sealed in a glass cell provided with a vent, into which water may be poured and be absorbed by the paper.

I do not herein lay any claim to the trans-

mitting-instrument, nor to the battery. I have shown these as adapted to the arrangement of circuit-connections represented.

I claim as my invention—

1. The combination, with a telephonic transmitter, receiver, and line, of a tertiary induction-coil, one coil of which is in the circuit to the receiver, the other in the circuit to the transmitter, and the third in the circuit to the line, substantially as set forth.

2. In combination with the transmitting and receiving instruments and a tertiary induction coil and circuits, substantially as set forth, a call and local battery of the character described, and the circuit-connections of the same, substantially as set forth.

3. In combination with a diaphragm and a moving surface, an arm extending from the diaphragm to the moving surface and tipped with palladium, for the purposes and substantially as set forth.

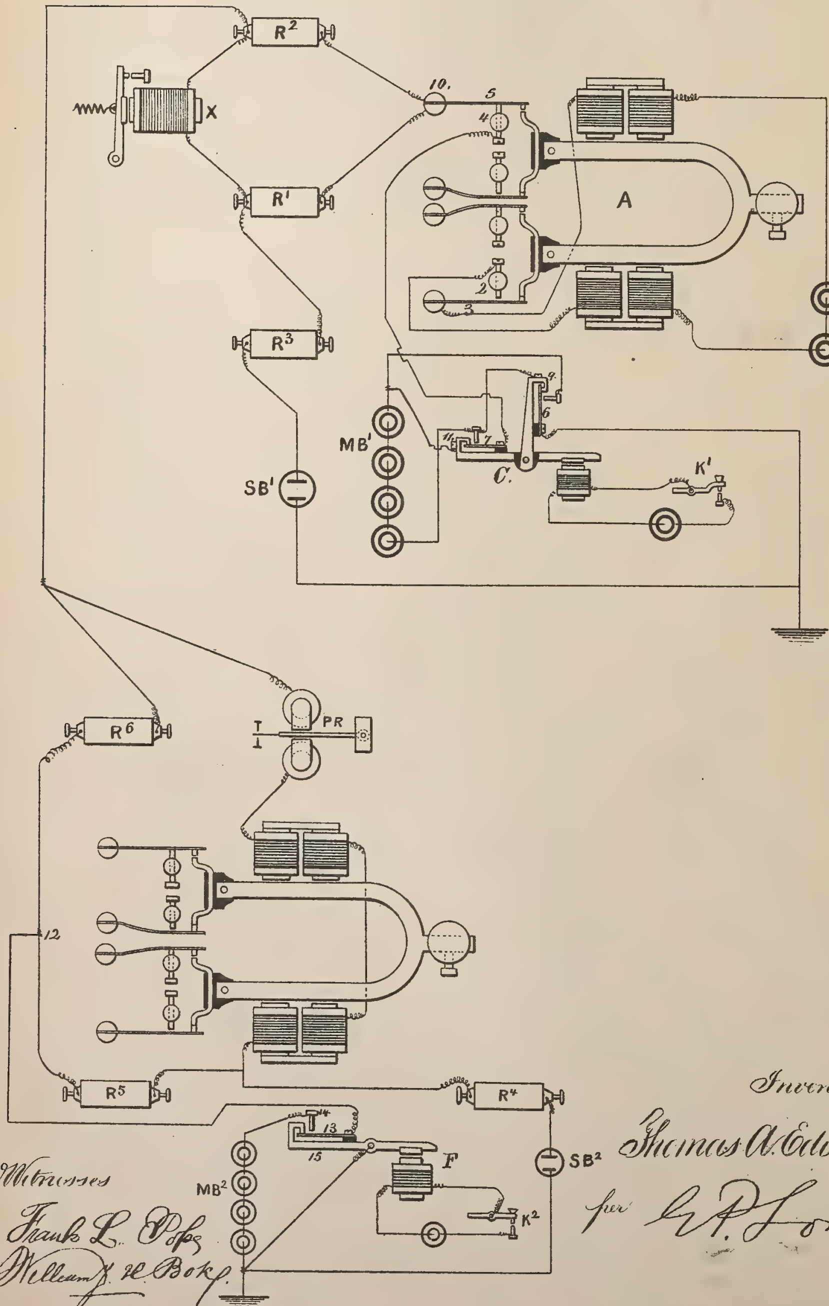
Signed by me this 17th day of July, A. D. 1879.

THOS. A. EDISON.

Witnesses:
S. L. GRIFFIN,
FRANCIS R. UPTON.

T. A. EDISON.
Acoustic Telegraph.

No. 235,142. Patented Dec. 7, 1880.



Witnesses
Frank L. Pope
William J. H. Bok

Inventor
Thomas A. Edison
per G. P. Lowrey
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, N. J., ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

ACOUSTIC TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 235,142, dated December 7, 1880.

Application filed September 30, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Acoustic Telegraphs, (Case No. 125,) of which the following is a specification.

In my Patent No. 198,089, granted December 11, 1877, vibrating reeds are actuated by electro-magnets in local circuits and move contact-points for opening and closing the battery-circuits and varying the tension on the line.

In my present invention I make use of a circuit preserving and reversing key at one station, a polarized relay at the other station, a key to bring into action additional battery-power and cause a response in a bridge-relay at the distant station. This has before been accomplished in telegraphs. I, however, make use of a circuit-breaker or pulsator in the main line operated by a tuning-fork, and this causes a corresponding vibration of another fork at the distant instrument by the action of electro-magnets in the bridge-wire. By this arrangement I am able to operate the usual duplex telegraph, and at the same time obtain synchronous movements at the two ends without one system interfering with the other.

In Letters Patent No. 185,507, granted to me, two tuning-forks at each end act, in connection with the transmitting and receiving devices, to direct the messages sent to the proper receiving-instruments.

In my present improvement the tuning-fork at the transmitting end causes the vibration of a similar tuning-fork in the bridge-wire of the receiving-instrument, and has nothing to do with the messages sent by the keys from either end.

The two tuning-forks vibrating in exact unison are available for any synchronous movement, or for any other duty in connection with telegraphy—such, for instance, as manipulating the connections of another wire, as set forth in my aforesaid Patent No. 185,507.

A is the fundamental tuning-fork, whose two magnets are placed in one local circuit, containing the battery B′, which circuit is interrupted by the movement of the fork itself at the points 2 and 3.

R′ and R² are resistance-coils, which form one side of the Wheatstone balance.

X is the common relay, placed in the bridge-wire.

R³ is a resistance-coil, which serves to form the artificial line, and is used for balancing the effect of the battery M B′ on the relay X.

S B′ is a large secondary battery, used for the purpose of creating extra currents to neutralize those produced up the line, and thus preserve the balance. The two sides of the balance meet at 10, and then proceed to the points 4 and 5, where the whole line is interrupted at each vibration of the fork A. From 4 it passes to the current-reversing transmitter C, entering at the spring 7, which rests (when the key K′ is open) against the prong 11, thence to the zinc pole of M B′, from the carbon pole to the prong 9, through to spring 6 to the earth, thus putting the zinc pole to the line.

When key K′ is closed the connection is changed in C, and the carbon pole of the battery is put to line. These reversed currents pass through the two sides of the balance R′ and R², and over the main and artificial lines, but do not pass through the bridge-wire containing relay X; hence this relay works perfectly independent of the current from M B′. These reversals pass over the line to the distant stations, and there set in motion the tongue of the polarized relay P R, which is placed, along with the acoustic instrument G in the bridge-wire of another balance. These reversals serve to transmit the necessary signals from key K′ to the polarized relay P R to transmit one message, and these reversals act as constant currents to the acoustic instrument, as its magnets are unpolarized and cannot discriminate between the two currents; hence it responds only to the total interruptions in the circuit by the fundamental fork A at the points 4 and 5. These interruptions, owing to their immense rapidity compared to the rate of signaling, do not affect the polarized relay P R.

R⁵ and R⁶ are two resistance-coils, which form the two sides of the Wheatstone balance, R⁴ and S B² forming the artificial line. The two sides of the balance are connected at 12, and thence to the transmitter F, which, if the key

K^2 is open, enters at the spring 13, thence through the lever 15, against which its end rests, to the earth. In this position the battery M B^2 is disconnected and the relay X at the distant station is open. If, now, the key K^2 be closed the point 14 comes in contact with the spring 13, separating it from 15, and connects the line to the battery, and thence to earth. This current passes to the distant station and closes the relay X, but does not pass through the bridge-wire containing the polarized relay P R or the fork G; hence these are never affected by the current from M B^2. The effect of the total interruption of the circuit at 4 and 5 of A does not in the least affect the reception of signals on X. Thus I am enabled to transmit and receive two messages over a wire at the same time that I am transmitting and receiving a series of non-signaling currents, which serve to synchronously vibrate two acoustical instruments.

The tuning-forks A and G are provided with extra points and springs, for use in operating one or more local circuits containing similar acoustical instruments, making the same number of vibrations or multiples thereof. Any number of tuning-forks, like G, may be inserted at intermediate stations, the local points of which can be used in connection with local forks for regulating purposes on other wires.

I will mention that reverse currents could also be sent through R^6 and R^5 over the line, to affect a polarized relay inserted in the bridge-wire with X if the former is provided with suitable devices to prevent a mutilation of the signals by the reversals.

In my application for a patent Case No. 99 the signals are made by two circuit-preserving keys, one of which varies the tension of the electric current, and the other reverses the polarity of the current.

In my application No. 132 there is a circuit preserving and reversing key in the main line and a polarized relay in the bridge; also, a pulsator of the current in the form of a tuning-fork that is kept in vibration by an electro-magnet in a local circuit, and there is a key and shunt connection, whereby the vibrations from the pulsator upon the line are controlled, and signals are received by a reed at the distant station that pulsates in harmony with the tuning-fork. This construction is adapted to the transmission through the same circuit of messages by the Morse system and the electro-harmonic or telephonic system. These features are therefore expressly disclaimed from this present application.

In my case No. 133, patented July 22, 1879, No. 217,781, there is a polarized relay, a magnet responding to rise and fall of tension, and a reed or telephone in the bridge, and circuit-preserving keys that reverse the polarity and produce rise and fall in electric tension, a tuning-fork vibrator, and a key that short-circuits the current around the said vibrator. I also disclaim the same from this application.

I claim as my invention—

The combination, in one telegraphic circuit, of circuit-preserving keys, one of which reverses the polarity and the other increases or decreases the battery-power, a polarized relay and receiving-relays in the respective bridge-wires, two vibrators and their actuating electro-magnets, the helix of one of which is in the main-line circuit and the helix of the other is in a local circuit, and a circuit-breaker in the local circuit operated by its pulsator, substantially as specified, whereby the two tuning-forks are caused to pulsate synchronously entirely independent of and without reference to the telegraphic communications by the respective keys, substantially as specified.

Signed by me this 26th day of August, A. D. 1876.

THOS. A. EDISON.

Witnesses:

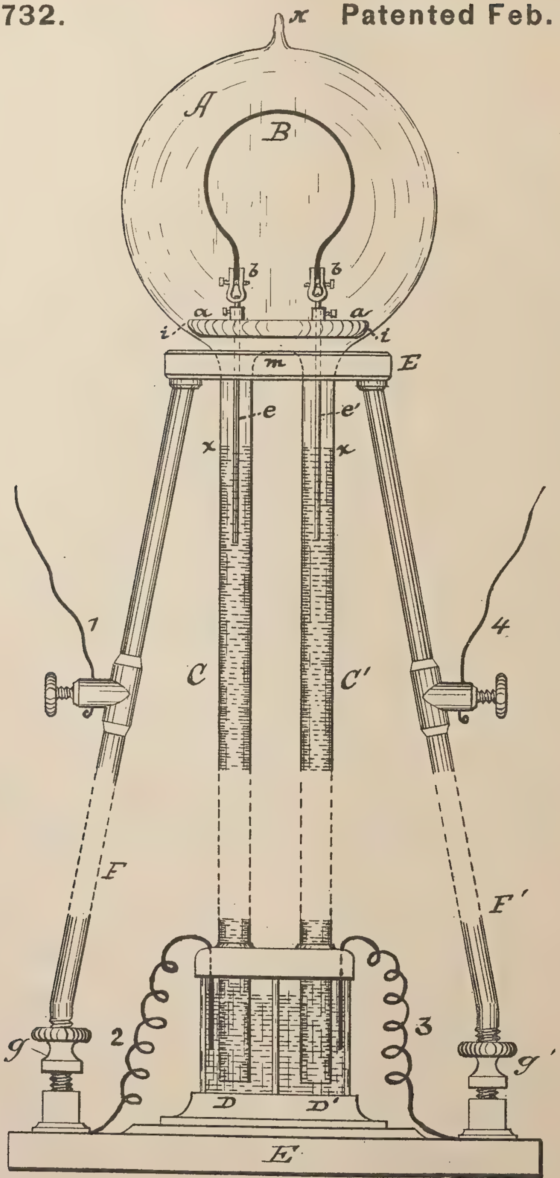
GEO. T. PINCKNEY,
CHAS. H. SMITH.

(No Model.)

T. A. EDISON.

Electric Light.

No. 237,732. Patented Feb. 15, 1881.



Attest:
S. D. Mott
James A. Payne

Inventor:
Thos. A. Edison
per Dyer & Wilber
Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LIGHT.

SPECIFICATION forming part of Letters Patent No. 237,732, dated February 15, 1881.

Application filed June 30, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Electric Light, (Case No. 220;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In several prior applications made by me, and in several patents granted me for improvements in electric lights, the light is produced by the incandescence of a conductor in a hermetically-sealed vessel, the incandescing conductor being the small carbon now generally designated as the "horseshoe carbon." Such, however, are designed for small lamps, usually fifteen to eighteen candle-power, and the conductor required therefrom, being small, is hermetically sealed in glass. When it is desired to produce on the same principle a much greater light—say, one hundred candle-power—the conductor thereto must be also much larger. While I have succeeded in satisfactorily sealing somewhat larger conductors hermetically in the glass, it is generally not so effective or desirable a method of passing large conductors into the bulb as where small conductors are used, wherefore there seems to be a necessity for some other method, which, in the case of large conductors, shall pass the conductors into the bulb of the lamp without contact with the glass thereof, and at the same time furnish an effective and lasting hermetical seal.

To furnish such a method is the object of this invention, which consists, in general terms, in the employment in the lamp of two columns of mercury, sustained in tubes attached to the lamp-bulb at ordinary barometric height by the pressure of the atmosphere, and serving both as seals to preserve the vacuum in the lamp-bulb and as parts of the circuit through the incandescent conductor; and the invention consists, further, in the devices and combinations for carrying the same into effect, as more particularly hereinafter described and claimed.

In the drawing, the figure is a view of a lamp embodying the invention, shortened somewhat in proportion to its height, as indicated in the dotted lines.

A glass globe or bulb, A, is blown, having an annular opening in its base of a size to admit of the base *a a* passing therethrough. The line of this opening is indicated at *i i*.

Upon the top of the bulb is formed a tube, (the continuation of the projection N,) by which the lamp is attached to the air-pump, as described in a prior application.

Upon a suitable base, *a a*, of insulating material, are fastened, by proper devices, the clamps *b b*, holding and supporting the horseshoe B, the clamps being connected to metallic conductors *e e′*, passing a little distance, say, several inches, below the base *a a*.

Two glass tubes, C C′, each of a diameter several times greater than that of *e* or *e′*, and several inches longer than a column of mercury supported *in vacuo* by atmospheric pressure, are united, near their top, as at *m*, and their united tops formed into a circle the diameter of or slightly larger than the diameter *i i* of the opening in A. The base *a a* supporting the carbon, and with its attached conductors, is introduced into A, and the tubes C C′ are then secured, by sealing at *i i* to A, the conductor *e* projecting downwardly into C, and *e′* into C′. For supporting the lamp thus formed, a stand is employed consisting of an insulating-top, E, and base E′, united by metallic standards F F′, which are connected to the base E′ by adjustable screw-connections *g g′*, so that, as circumstances require, the top may be raised, lowered, or inclined. Upon the metal standards F F′ are binding-screws, whereby conductors 1 4 to and from the source of electric energy are attached. The top E is provided with a central aperture, or it may be annular, permitting the tubes C C′ to pass through and below it, while supporting the globe.

Upon the base E is located a vessel made of insulating material not affected by mercury, divided into compartments D D′; or two separate distinct vessels may be used. The tube C passes into one, D, to near its bottom, while C′ passes into D′. A wire, 2, connects D and F, and a wire, 3, connects D′ and F′.

The parts being placed in position as shown in the figure, the vessels D D′ are filled with mercury, and the tube-continuation of N, before mentioned, fastened to the pumps. As the air is exhausted from the bulb the mer-

cury rises in C and C′. During this operation care must be taken that the compartments D D′ are kept supplied with mercury, and that upon the completion they are still full. Upon the proper degree of vacuum being attained the bulb is sealed at N and the tube removed. At this stage the mercury has risen to and remains at x x—the height at which atmospheric pressure sustains a column of mercury *in vacuo*—the mercury contacting with e e' and passing a little distance above their ends.

The columns C C′ should be of such a diameter as to give no greater resistance to the circuit than does either of the conductors e e', 2, or 3.

For high candle-power incandescent lamp this arrangement makes a very reliable and durable seal, obviating any danger there may be of seal-breakage arising from difference of expansion coefficient likely to exist where a large metallic conductor is sealed directly to or in glass. For such reason, in large lamps, this method may prove preferable to that of sealing direct, as shown in some of my prior applications.

What I claim is—

1. The combination, with the incandescing conductor of an electric lamp, of two fluid columns sustained by atmospheric pressure and forming both a part of the circuit and the hermetical seal to the lamp, substantially as set forth.

2. The combination, with the incandescing conductor and the fluid columns, of reservoirs connected to the source of electricity, and into which the columns dip for the maintenance of the column and the completion of the circuit therethrough, substantially as set forth.

3. The combination, with an electric lamp, of the stand or support therefor, consisting of an insulating base and top connected by adjustable standards, substantially as set forth.

This specification signed and witnessed this 15th day of June, 1880.

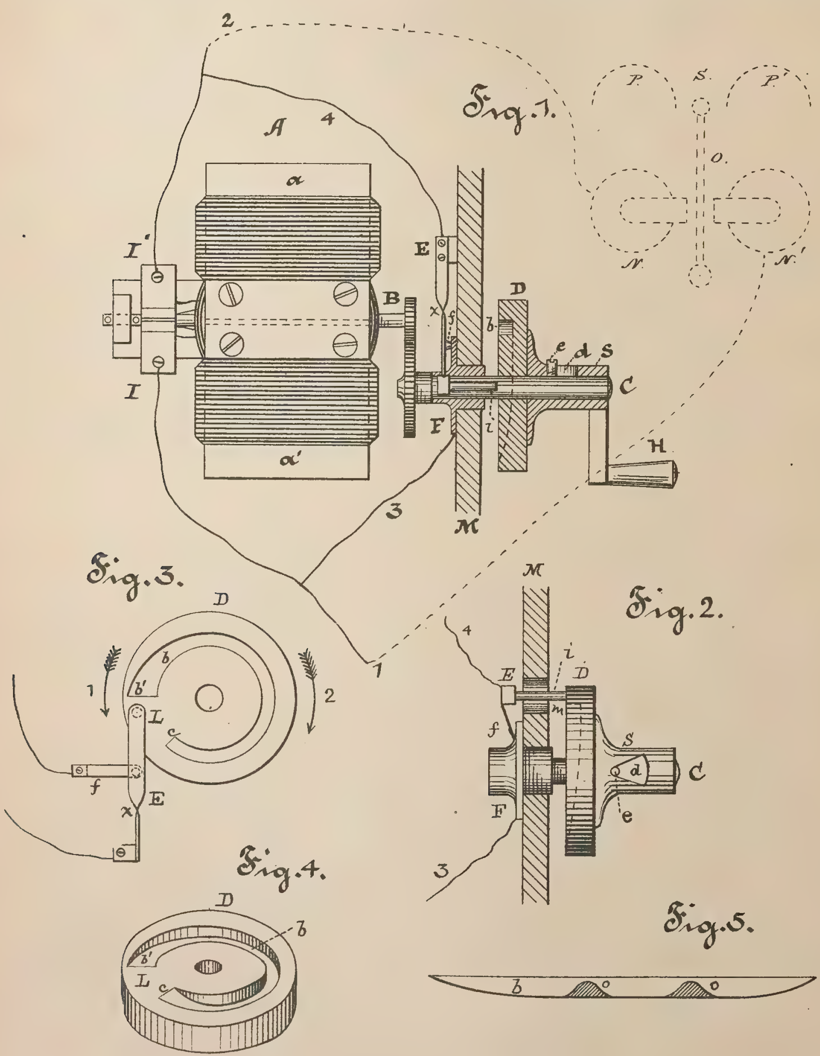
THOMAS A. EDISON.

Witnesses:
S. L. GRIFFIN,
WM. CARMAN.

(No Model.)

T. A. EDISON & E. H. JOHNSON.
Magneto Signal Apparatus.

No. 238,098. **Patented Feb. 22, 1881.**



Attest:
S. D. Mott
F. W. Howard

Inventors:
Thos. A. Edison
Edward H. Johnson
per Dyer and Wilber
Attys.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON AND EDWARD H. JOHNSON, OF MENLO PARK, N. J.

MAGNETO SIGNAL APPARATUS.

SPECIFICATION forming part of Letters Patent No. 238,098, dated February 22, 1881.

Application filed November 11, 1880. (No model.)

To all whom it may concern:

Be it known that we, THOMAS A. EDISON and EDWARD H. JOHNSON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Magneto Signal Apparatus; and we do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

Magneto-electric machines as signal apparatus are often used in such relation to other devices that it is desirable that they should be cut out of circuit when not in use, being thrown into the circuit only when in use.

It is often desirable that they should, without any change at the time of use, be capable of giving two distinct signals—as, for instance, a continuous ring and an intermittent ring, indicating two distinct wants or operations or things. The accomplishment of both these results in one organization is the object of this invention. The arrangement for accomplishing generally the first result above noted is not herein claimed, *per se*, as such is the subject of a prior application for a patent made by us jointly; but such is claimed herein only in connection with the other novel arrangements, by which both results in one instrument are rendered practicable.

In carrying the invention into effect a shunt-circuit is formed around the magneto machine or generator, connected to the main circuit upon each side of the generator, a portion of which circuit is a contact spring or lever, taking against an anvil or contact-point. The actuating handle or pulley is attached to a sleeve which is loose upon the main driving-shaft, but secured thereto by a pin on the shaft taking in a triangular opening or slot in the side of the sleeve. Upon the inner end of the sleeve is a disk, which takes against a rod whose other end bears against the contact spring or lever. The force of the contact-spring, or that of a special spring, is used to normally hold the rod pushed against the disk, so that the sleeve is as far out on the shaft as the slot and pin permit, in which condition the spring impinges on the anvil or contact-point, closing the shunt-circuit, thus practically cutting the generator out of circuit. Upon rotation the sleeve turns loosely upon the shaft until the outer end of the slot reaches the pin, when sleeve and shaft turn together. The slot being triangular causes the carrying inward of the sleeve and disk, pushing the rod against the contact-lever or spring, causing it to leave the contact-point or anvil, breaking thereby the shunt or short circuit, compelling the current from the generator to traverse the main circuit. Upon cessation of use the parts return to their normal position, closing the shunt or short circuit. By the arrangement thus described the first of the objects noted is accomplished.

To accomplish the second object the arrangement noted is modified, as follows:

The contact-spring referred to is made with a twist about its center, so as to be capable of motion in either direction. To it is attached directly the pin which takes against the disk upon the sleeve. In the inner face of the disk a groove is cut, extending partly around the disk, and whose outer edge normally is out of the path of the pin. One end of this groove is broadened somewhat by its outer edge being carried by an easy curve into the path of the pin. At both ends the descent from the face of the disk to the bottom of the groove is by an incline, so that the pin may enter or emerge from the groove without jar. As before stated, the groove extends only partially around the face of the disk, leaving a "land" of the normal plane of the disk between the ends of the groove. If the sleeve be turned in the direction of the narrow end of the groove, the pin takes against the face of the disk outside of the groove and is simply pressed in, breaking the shunt-circuit, as before explained, causing continuous waves of current to be sent upon the line, and a continuous signal to be made—say a continuous ringing of a bell. If, however, the sleeve be turned in the opposite direction, the pin is hit by the outer edge of the broadened end of the groove and carried inward slightly, the pin taking in the groove, leaving the shunt closed so long as the pin is in the groove, the pin being forced inward, and the shunt consequently broken, only when the pin passes out of the groove and rides upon the land. By this means the current is sent upon the line during a part of each revolution only, with the result that an intermittent signal, or a signal composed of sounds with intervening pauses, is given. In the bottom of the groove referred

to could be made a series of inclined or cam faces, following each other in any desired sequence, so that a regular dot and dash or any other arbitrary signal could be given. This arrangement permits of two distinct signals being given without change of apparatus or any operation on the part of the operator, except the mere change of direction of rotation. This may be better understood by reference to the drawings, in which—

Figure 1 is a plan view of an apparatus embodying the invention; Fig. 2, a side view; and Figs. 3, 4, and 5, views of details.

A is a magneto-machine with field-magnets *a a'*, between whose polar extensions rotates the armature B, which is provided with commutators I I', from which lead the wires 1 2 of the main circuit. This magneto-machine may be of any desired description, the one here represented being used simply as a type of that class of machines.

C is the main driving-shaft, connected to the shaft of the armature B by gearing, although it is evident that the shaft C may be the shaft of the armature.

Upon the shaft C is a loose sleeve, S, to which is attached the handle H; or a pulley or other equivalent may be substituted for the handle.

In the side of the sleeve S is the recess or slot *d*, in which takes the pin *e*, secured in shaft C, uniting the shaft and sleeve, but allowing a limited motion of the sleeve upon the shaft, determined by the size of the recess.

Upon the inner end of the sleeve is the disk D, in whose inner face is the groove *b*, extending partially around the disk, as more clearly shown in Figs. 3 and 4. As shown, one end, *b'*, of the groove is wider than the other end, *c*, the widening being effected by a curving outward of the outer edge of the groove. At both ends the bottom of the groove comes up to the land L between the ends of the groove by a gradual incline. The disk D takes against the pin *i* on spring E, a part, *f*, of which normally makes contact with the contact-point or anvil F. The pin *i* passes through a slot, *m*, in the side of the box or framing. The spring E is twisted at *x*, so that its flat surface lies in two planes at right angles to each other, but having a common axis, so that it has a movement in two directions.

A shunt-circuit is formed by conductors 3 and 4—3 from 1 to the anvil F, and 4 from 2 to the spring E. In the main-line circuit any number of suitable signal devices are placed, one being shown in dotted lines as a type, N N' being the magnets thereof, between whose polar extensions plays the polarized armature-lever O, whose outer end, S, strikes upon the bells P P'. Normally the parts are in the position shown in Figs. 1, 2, and 3, the stress of spring E, acting through pin *i*, forcing the sleeve outward and keeping closed the shunt-circuit at *f*, Fig. 1. If, now, the sleeve be turned in the direction of arrow 2, Fig. 3, the sleeve at first turns loosely on the shaft C; but the pin *e*, taking against the inclined face of the opening *d*, causes it to move inward, forcing back the pin *i* and spring E', breaking the shunt-circuit. The shaft and sleeve then move together, and as the pin *i* takes upon the plane of the disk outside of the groove, the shunt-circuit is kept broken and a continuous current is sent, which may be utilized for a continuous signal-call or other purpose. If, however, the sleeve be turned in the direction of arrow 1, Fig. 3, the pin *i* is caught by the enlarged end *b'* of the groove, and remains in the groove during a part of the rotation. During such part the shunt is not broken and no current goes to the line. As the pin rises up out of the groove and passes over the land L, the shunt is broken during the time of its passage over such land and a current is sent to line. Thus during each revolution of the disk there is a period of current and a period of no current, so that a signal given is intermittent or broken up.

Fig. 5 is a diagrammatic representation of a groove straightened out. In the bottom of the groove inclined or cam surfaces *o o* could be made in such order, sequence, or relation to each other as might be desired, so that a definite number, letter, or other arbitrary signal could be given.

While in this arrangement the sleeve is shown as mounted upon the main driving-shaft, it is evident that it need not always be placed thereon, but that it may be mounted upon any other shaft, or on a special shaft driven from the main driving-shaft.

What we claim is—

1. The combination, with a magneto machine and its main circuit, of a shunt or short circuit, and means for automatically breaking such short circuit entirely upon movement in one direction, and intermittently breaking it upon movement in the other direction, substantially as set forth.

2. The combination of the driving-shaft of a magneto-electric machine, a sleeve mounted thereon in such manner as to have a determinate longitudinal movement thereon, and a circuit-breaker automatically operated by such sleeve, to break a circuit entirely during movement in one direction and intermittently during movement in the other direction, substantially as set forth.

3. The combination, with a magneto machine, of means, substantially as described, for producing a definite audible signal upon rotation of the driving-shaft in one direction and a definite different audible signal upon rotation of the driving-shaft in another direction, substantially as set forth.

This specification signed and witnessed this 21st day of October, 1880.

THOS. A. EDISON.
EDWD. H. JOHNSON.

Witnesses:
JOHN F. RANDOLPH,
WM. CARMAN.

(No Model.)

T. A. EDISON.

Manufacture of Carbons for Incandescent Electric Lamps.

No. 238,868. Patented March 15, 1881.

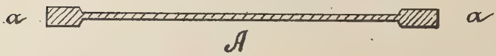


Fig. 1.

Fig. 2.

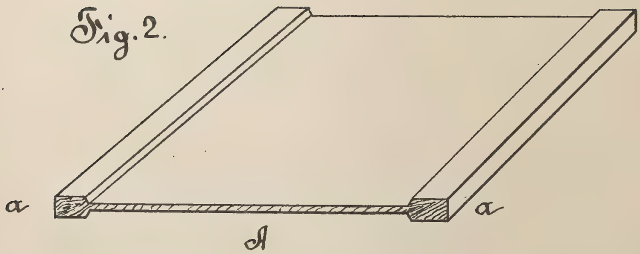
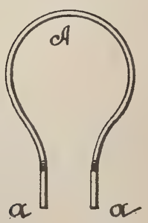


Fig. 3.



Attest:

Saml. D. Mott,

James A. Payne.

Inventor:

T. A. Edison,

per Dyer & Wilber,

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MANUFACTURE OF CARBONS FOR INCANDESCENT ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 238,868, dated March 15, 1881.

Application filed May 24, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Method of Manufacturing Carbons for Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In other applications for patents by me made has been set out the necessity, in electric lamps lighting by incandescence, of carbons of high resistance in small bulk, and of little or no tendency to disintegration upon being highly heated; and, further, that simple wood carbons of unchanged structural condition possess these qualities.

The invention in the present case relates to a method of manufacturing such carbons.

As is well known, I ordinarily use in my lamps an incandescing material of very small cross-section, often a mere filament. This necessitates a broadening or thickening at the ends, in order to afford good contact with the clamps used. A block of wood is taken and cut or formed so that its center shall be a web, bounded at the sides by thicker portions. The grain of the wood is from side to side, and the thickness of the web is about the desired breadth of the carbon. From the block so fashioned pieces whose width approximates the desired thickness of the carbon are split, shaved, or cut off. These pieces are then sufficiently softened by moisture and heat so as to be bent into a circular or horseshoe or oval form, and they are retained in such shape in a proper carbonizing-flask and carbonized.

In the drawings, Figure 2 represents a block formed as before described; Fig. 1, a piece split, cut, or shaved therefrom; and Fig. 3, the same after carbonization.

A is the web of the block, the center of the block being reduced in thickness, while the ends *a a* are left broad or thickened for fastening to the clamps. This block is split, cut, or shaved into pieces, like Fig. 2, which are then bent into shape shown in Fig. 3, or into any other desirable shape, and then carbonized while in such forms. The result is a carbon with broadened ends for clamping, unitary with itself, and which is porous, structurally unaltered, of high resistance, and with a minimum tendency to disintegration under high heat.

It is evident that the block shown in Fig. 2 could be made of disintegrated fiber, paper-pulp, papier-maché, &c., by powerful pressure, and the individual carbons then cut off from such block; but in practice I so far prefer to make the block and resultant carbons of wood.

What I claim is—

1. The method of forming carbons for electric lamps, which consists in shaping a block of wood as described, then cutting, splitting, or shaving into straight pieces, adapted for simple carbons, then bending such pieces into the desired form and carbonizing in such form, substantially as described.

2. The block for the manufacture of carbons for electric lamps, consisting of the central web and thickened or broadened ends, substantially as described.

This specification signed and witnessed this 25th day of April, 1880.

THOMAS A. EDISON.

Witnesses:
WM. CARMAN,
Z. F. WILBER.

(No Model.)

T. A. EDISON.

System of Electric Lighting.

No. 239,147. **Patented March 22, 1881.**

Fig. 1.

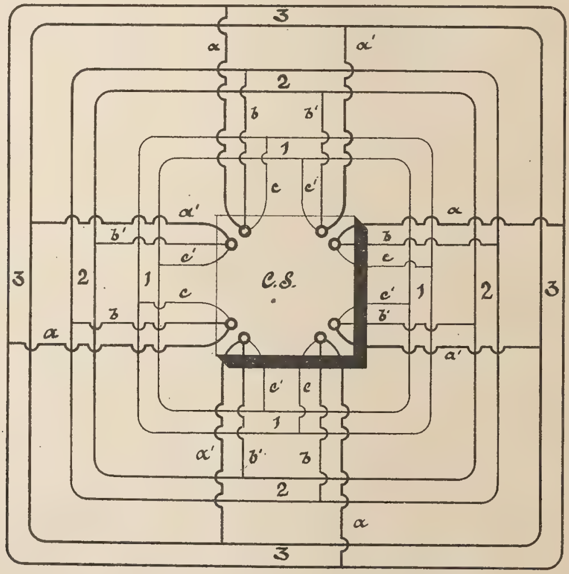
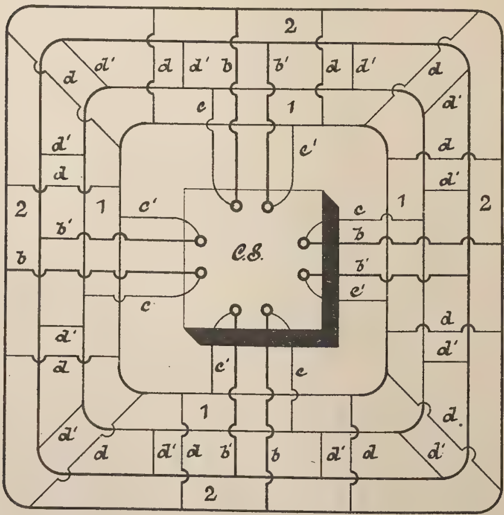


Fig. 2.



Witnesses:

O. D. Mott,

E. Berggren.

Inventor:

Thos. A. Edison,

per Dyer and Wilber,

Attorneys.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SYSTEM OF ELECTRIC LIGHTING.

SPECIFICATION forming part of Letters Patent No. 239,147, dated March 22, 1881.

Application filed August 9, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electric Lighting; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This invention relates to a system of laying the conductors conveying the current from a central station or source of electric energy throughout a system of electric lighting or translation.

Where many translating devices, converting electricity into either power or light, are arranged upon the multiple-arc or derived-circuit system, it is essential that, so far as possible, an equal electro-motive force or pressure be maintained in all parts of the system. When, however, each set of conductors is run out from the central station in a straight line, or in lines, the pressure, when a number of devices are in operation, is apt to be greatest nearest the central station, and to diminish gradually toward the end of the conductors.

The object of this invention is to obviate such danger and to maintain practically throughout the entire system an equal pressure; and to this end it consists in the features more particularly hereinafter set forth and claimed.

In the drawings, Figures 1 and 2 are diagrams illustrating the method of arranging the conductors.

C S is the central station, around which, following the general direction of the blocks or squares of the locality, are laid the sets of conductors 1, 2, 3, &c., so that they are, so to speak, concentric with each other. From the central station branch conductors lead to each of the main sets 1 2 3 at a number of points. For instance, *a a'* lead to set 3, *b b'* to 2, *c c'* to 1. In Fig. 1 eight sets of branch conductors are shown leading to each of the main sets. In Fig. 2 two sets of main conductors, 1 2, are shown connected to the main station by four sets each of branch conductors, *b b' c c'*, differing, however, from Fig. 1 in that the main sets 1 2 are connected together by numerous sets of coupling-conductors, *d d'*. As proceeding from the central station, each set of main conductors traverses a larger area of territory and has a larger amount of work to do. If all of the conductors were of the same size, there would be increased resistance. It is desirable, however, that each (no lamps on branch conductors or couplers) set should be of the same resistance, and that the same ratio of resistance of conductor to translating device should exist in all the sets. This is accomplished by increasing the size of the conductors as they are laid farther away from the central station. Having determined the relative resistance which should exist between the resistance of the conductors and that of the sum of translating devices most probably to be used with such conductors, the increase of size to be given is that which shall preserve such ratio, taking into consideration the increased length of conductor and the increased number of devices to be probably supplied thereby. By this method of laying and uniting the conductors an equal pressure or electro-motive force may be maintained throughout an entire system.

What I claim is—

1. The method of laying the conductors in an electrical-supply system, consisting in laying them in sets concentrically, as explained, each set being connected to the central station at several points, substantially as set forth.

2. The method of laying the conductors in an electrical-supply system, consisting in laying them in sets concentrically, as explained, each set being connected to the central station by several sets of branch conductors, and the various sets being connected to each other by several sets of coupler-conductors, substantially as set forth.

This specification signed and witnessed this 31st day of July, 1880.

THOS. A. EDISON.

Witnesses:
WM. CARMAN,
S. L. GRIFFIN.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

TREATING CARBONS FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 239,148, dated March 22, 1881.

Application filed October 30, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Method of Treating Incandescing Conductors for Electric Lamps; and I do hereby declare that the following is a full and exact description of the same.

As has been fully explained in prior applications by me made and in Letters Patent granted to me, the best incandescing conductors for incandescent electric lamps are made by cutting or forming a suitable fibrous material into the proper shape, and then carbonizing the same by subjecting them to a very high temperature in closed flasks.

In the process of carbonization the element most difficult to eliminate is hydrogen, a large percentage of hydrogen remaining in the carbons, which cannot be removed, even at the highest temperature to which the flask can be brought without melting it.

The object of this invention is to furnish a method by which the hydrogen may be removed, which is accomplished as follows: Chlorine gas, or some gas which combines readily with hydrogen, but not with carbon, is passed through the flask while the same is heated. The chlorine unites with the hydrogen, insuring its removal.

If desired, the process of carbonization may take place in one flask and the carbons then removed to another flask, where the chlorination may be effected.

What I claim is—

The method of removing hydrogen from carbons, consisting in passing a stream of chlorine or equivalent gas through the flask containing the carbons heated to a high temperature, substantially as set forth.

This specification signed and witnessed this 15th day of October, 1880.

THOS. A. EDISON.

Witnesses:

CHAS. BATCHELOR,

WM. CARMAN.

(No Model.)

T. A. EDISON.

Incandescing Electric Lamp.

No. 239,149. Patented March 22, 1881.

Fig. 1.

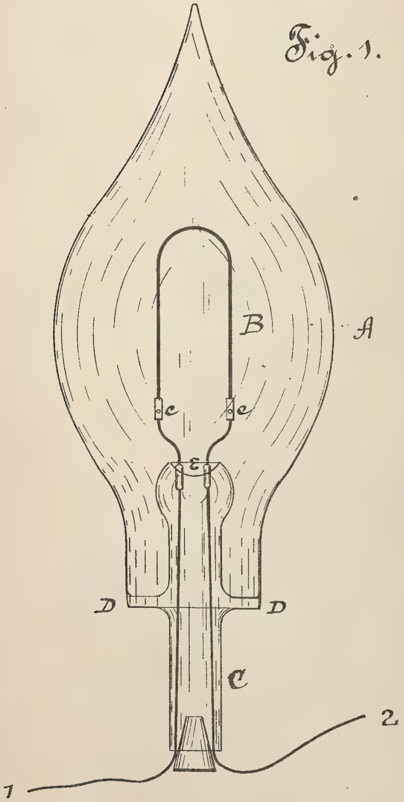
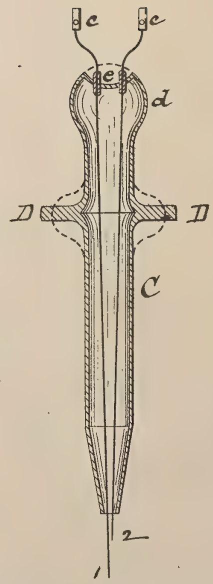


Fig. 2.



Attest:
O. D. Mott
F. W. Howard

Inventor:
Thos. A. Edison,
per Dyer & Wilber
Attys.

N PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D C

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCING ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 239,149, dated March 22, 1881.

Application filed December 15, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to incandescent electric lamps, and is intended as an improvement on the form shown in Letters Patent No. 230,255, issued to me July 20, 1880.

In the lamp described in the above patent the glass stem through which the wires pass has a round bulb at the top, in which the wires are sealed, and a round enlargement below this bulb, which supports the exterior globe of the lamp. The interior of this globe being a vacuum, while the interior of the inside stem is filled with air, a considerable pressure is exerted on the inner surface of the upper bulb, and this pressure is exerted on the weakest part—a concave surface. Therefore, in my present invention, I make this bulb with a depression in its top, so that the atmospheric pressure is exerted on a convex surface, which is less likely to be injured thereby.

In some cases, instead of a hollow spherical enlargement of the stem as a support to the globe, it may be desirable to use a solid projection extending from the sides of the stem as a support for the globe, and to which the globe is sealed.

My present invention, then, consists, first, in constructing the upper bulb with a concavity or depression in its top; and, second, in a support for the globe formed of a projection extending laterally from the stem and forming a part thereof.

In the accompanying drawings, Figure 1 is a sectional view of an entire lamp constructed according to my invention, and Fig. 2 a sectional view of the interior glass stem.

The dotted lines in Fig. 2 show the construction of the bulbs, as patented by me in the above-mentioned Patent No. 230,255.

A is the exterior globe, and C the interior glass stem, through which the wires 1 2 of the circuit pass, being sealed in the glass where they pass through it, and terminating in the clamps *c*, which hold the carbon B. At *d* a bulb is blown on the stem, depressed or hollowed out at *e*. At D D an enlargement is also blown on the glass; but while the glass is soft it is flattened down, and forms the projection or ring of glass shown. It is of the same width as the lower part of the globe A, which they support, and to which they are hermetically sealed.

Under some circumstances, and for some purposes, this form possesses considerable advantages over the form before patented by me, inasmuch as the bulb *d* is less liable to breakage, and a better support is afforded for the globe by the projection D D.

What I claim is—

1. In an incandescing electric lamp, the supporting-neck formed with a concavity at the point where the leading wires pass through and are sealed therein, substantially as set forth.

2. The supporting-neck formed with a solid glass projection, to and upon which the inclosing-globe is supported and sealed, substantially as set forth.

This specification signed and witnessed this 3d day of December, 1880.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
S. D. MOTT.

(Model.)

T. A. EDISON.
Electric Lamp.

No. 239,150. Patented March 22, 1881.

Fig. 1.

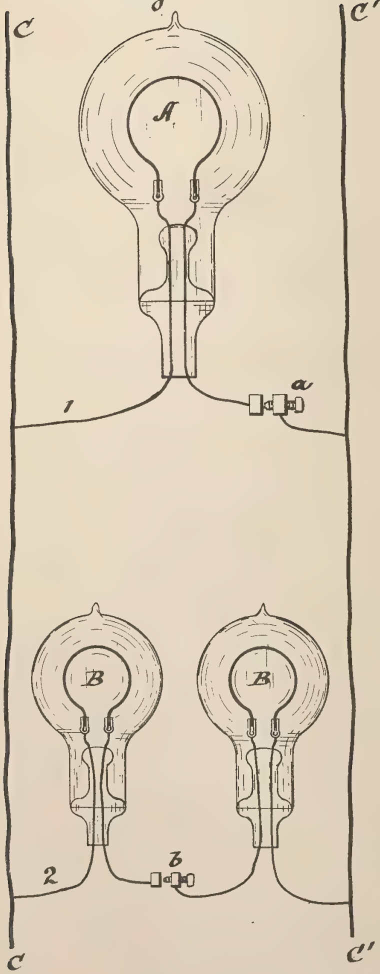


Fig. 2.

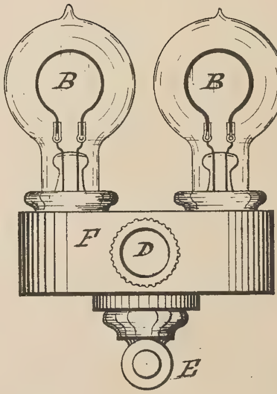
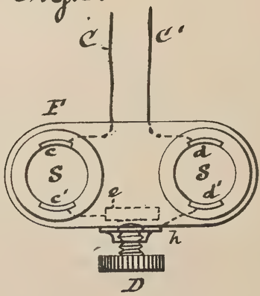


Fig. 3.



Attest:
S. D. Mott
S. H. Hall

Inventor:
Thos. A. Edison
per Dyer & Wilber
Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 239,150, dated March 22, 1881.

Application filed August 6, 1880. (Model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In a system of electric lighting such as proposed by me, in which separate electric lamps devoid of regulating devices are used at the places of consumption, the entire regulation for all the lamps being performed at the central station, as with water or gas supply, it is essential that a constant electro-motive force or pressure be maintained; and as in such a system the lamps are arranged upon the multiple-arc or derived-circuit system, it is essential that there should be a certain standard resistance in each derived circuit. This has been attained by placing one lamp of such standard resistance in each derived circuit.

It is desirable that all lamps used should be of equal lighting value, each giving a certain standard amount of light. This has been attained by giving each a certain definite or standard amount of radiating-surface. Ordinarily this radiating-surface has been that which, with the standard pressure or electromotive force and the standard resistance, should give a light equal to sixteen candles. Sometimes, however, it is desirable in some part of the system to use lamps which each give a much less amount of light—for instance, in chandeliers, where it is desired to divide the total amount of light produced among a larger number of lamps than ordinary—that is, that the light of one (say standard sixteen-candle) lamp be divided between two, three, or four lamps, each of eight, five and one-third, or four candle power, respectively. To attain this is the object of this invention, which is carried into effect in the following way, taking for example the substitution of two lamps for one in a derived circuit.

In a derived circuit are placed two lamps, each being carefully provided with an incandescing conductor of one-half the resistance and one-half the radiating-surface of the resistance and radiating-surface of the incandescing conductor of the standard lamp of the system. A single circuit-breaker is provided for both lamps, in order that both shall be turned off or on simultaneously. When desirable, the two lamps may be arranged in one holder, which may form a bracket, or may form a section of a group of lamps or of a chandelier.

In the drawings, Figure 1 is a diagram showing one standard lamp and two half-lamps in derived circuits from the same main conductor. Fig. 2 is a view of two half-lamps arranged in one holder, and Fig. 3 is a diagram showing the connections in such holder.

C C′ are the main conductors leading to and from any suitable source of electric energy at the central station. In the multiple arc 1 thereto is a lamp, A, of standard resistance and radiating-surface. In the multiple arc 2 are the two lamps B B, each of which has just one-half the radiating-surface and one-half the resistance of A. One circuit-breaker, *b*, is provided, controlling the circuit through both lamps. As a consequence, with a uniform standard electro-motive force or pressure, each of these lamps will give one-half the light which A would give.

If it is desired to increase the number, there should be the same proportion between the number used and the standard resistance and radiating-surface.

For two, three, or more lamps, a suitable holder, F, of insulating material, is made, sockets S being made therein for each lamp. In each socket metallic conducting-plates are placed on opposite sides, as *c c′ d d′*, for forming contact with metal slips or pieces on the necks of the lamps. The socket may be provided with a plain or screw-threaded aperture, E, by which it may be attached to the wall as a bracket, or to a framing, so that it may constitute a portion of a group of lamps or of a chandelier. Upon the socket is a circuit-breaker consisting of a metallic screw, D, secured in a seat, *h*, and which may be turned to impinge upon or be cleared from contact with a metal block, *e*.

The conductor C passes through *c c′* to *e*, and the conductor C′ through *d d′* to the metal

seat *h* of the screw D. If more than two are used, the block *e* and screw D are placed somewhere in the circuit leading through all the lamps, in order that all may be turned on or off simultaneously, all the divided lamps being used as one standard lamp.

What I claim is—

1. The combination, with one derived circuit, of a multiple-arc system of two or more lamps, each of a fractional resistance and radiating-surface of the resistance and radiating-surface of the standard lamp of the system, the fraction being the number used, substantially as set forth.

2. The combination, with one socket or holder and one derived circuit, of one circuit-controller and two or more lamps, each of a fractional resistance and radiating-surface of a standard lamp, substantially as set forth.

This specification signed and witnessed this 27th day of July, 1880.

THOS. A. EDISON.

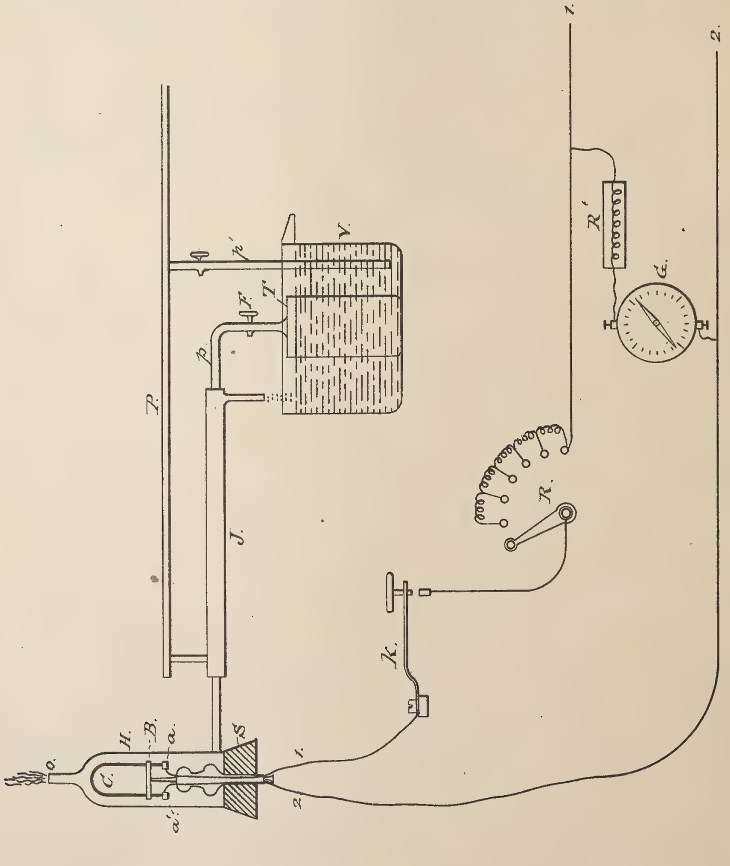
Witnesses:
S. D. MOTT,
WM. CARMAN.

(No Model.)

T. A. EDISON.

Method of Forming Enlarged Ends on Carbon Filaments.

No. 239,151. Patented March 22, 1881.



Attest:
S. D. Mott.
H. W. Howard

Inventor:
Thos. A. Edison
per Dyer & Wilber
Attys.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

METHOD OF FORMING ENLARGED ENDS ON CARBON FILAMENTS.

SPECIFICATION forming part of Letters Patent No. 239,151, dated March 22, 1881.

Application filed November 24, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Method of Forming Enlarged Ends on Carbon Filaments; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

As hitherto explained in various applications for patents by me made and now on file, very desirable carbons for incandescent electric lamps may be made of various vegetable fibrous substances. As the body or illuminating portion of such carbons is exceedingly small—a mere filament or thread-like body—it is necessary that they be provided with ends greatly enlarged, in order to afford a good electrical contact with the clamps in which they are secured. With some materials, such as paper, wood, bamboo, &c., it is possible to make these enlarged ends integral with and a part of the carbon itself, by suitably shaping the material prior to carbonization. Other fibers, however—such, for instance, as "monkey-bast"—are simple filaments, and the enlarged ends have to be built upon them. In prior applications I have disclosed several methods of accomplishing this.

The object of this invention is to furnish another method and means for making the necessary enlarged ends, and to that end it consists in the features more particularly hereinafter described and claimed.

In carrying the invention into effect, a carbon is so attached to electrical conductors that a current shall be passed only through the portion or portions which it is desired to enlarge. It is then placed in a glass globe or receiver having a small opening in its top. Connected with the globe are means for generating and passing into the globe a stream of hydrocarbon vapor capable of decomposition under high heat. In the electrical circuit are placed resistances, by which is regulated the pressure of the current passing through the carbon. A shunt is arranged with a galvanometer and resistances, so that the amount of current passing through the carbon may be regulated. The vapor is allowed to pass through the globe until all the air therein is displaced, the excess of vapor being burned at the opening in the top of the globe. The circuit being closed, the portions of the carbon through which it passes are heated thereby to incandescence, decomposing the vapor contiguous thereto, with the result that the carbon therefrom is deposited upon the heated portion of the conductor. The process is kept up until the portions referred to are sufficiently enlarged.

In the drawing is shown an arrangement of means well calculated to carry into effect the invention, although the invention is not limited to the employment of the precise means therein illustrated.

H is the glass globe or holder, having aperture *o* in its top, while the bottom thereof is sealed by the stopple S, through which passes the support of the carbon C. The carbon C is secured in temporary clamps B *a a'*, of which *a* is connected to conductor 1, and *a'* to conductor 2, of a circuit of any suitable source of electricity, while the clamp B connects both limbs of the carbon, so that the circuit is *via* 1 *a* B *a'* 2. The distance between B, *a*, and *a'* is equal to the portion of the carbon which it is desired to enlarge.

V is a water-reservoir, in which is a tank, T, for containing a carbon compound capable of vaporization under moderate heat. From it a pipe, *p*, leads to and communicates with H.

P is a steam-pipe having a branch, *p'*, leading into V, and another leading into the jacket J around *p*. Steam being admitted thereto heats the water in V, causing the vaporization of the compound in T, while the steam in jacket J heats *p* to a degree preventing condensation therein.

R is an adjustable resistance placed in one branch of the circuit, so that the electro-motive force or pressure of the current passing from *a* to B, and from B to *a'*, may be regulated.

G is a galvanometer, and R' an adjustable resistance in a derived circuit to 1 2, forming a shunt to the carbon, so that the amount of current passing thereto may be indicated and regulated.

The parts being in position, the vapor from T passes through H, the surplus burning at *o*

and preventing access of air to the interior; the circuit is closed at K, whereupon the carbon between a and B and a' and B is heated, decomposing the vapor and causing a deposition of carbon upon the heated portions. This deposition is symmetrical and uniform, and is allowed to proceed until the portions are sufficiently built up to afford good clamping-surfaces.

Instead of a separate tank for the carbon compound, a small reservoir may be made, directly attached to and communicating with the globe or receiver H, and a piece of solid carbon compound, such as solid naphthaline, placed in such small attached reservoir. Heat being applied thereto, carbon vapor passes into the globe and over and around the carbon under treatment, with the same result as in the other construction.

I do not claim herein, broadly, the deposition of carbon by electrical incandescence from a carbon compound, as such was practiced in early years by Buff and Hoff, and others; but

What I do claim is—

1. The method herein described of forming enlarged ends upon carbon conductors, consisting in forming an electrical circuit only through the portion desired to be enlarged, thereby heating the same in a vessel through which flows a stream of vapor from a carbon compound, substantially as set forth.

2. The combination of a receiving globe or chamber, means for passing therethrough a stream of vapor from a carbon compound, and means for forming an electrical circuit through any desired portion or portions of a carbon conductor within said globe or chamber, substantially as set forth.

This specification signed and witnessed this 19th day of November, 1880.

THOS. A. EDISON.

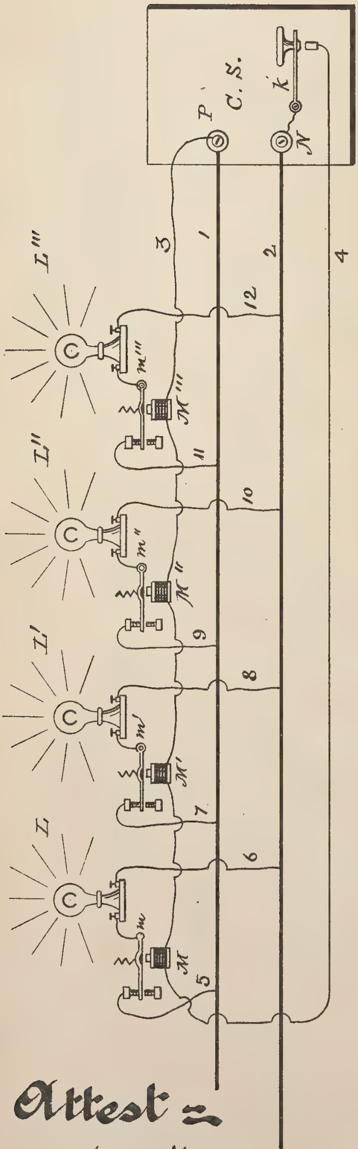
Witnesses:
WM. CARMAN,
ERNEST J. BERGGREN.

(No Model.)

T. A. EDISON.

System of Electric Lighting.

No. 239,152. Patented March 22, 1881.



Attest =

S. D. Mott

H. W. Howard

Inventor =

Thos. A. Edison

per Dyer and Wilber

Attys.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SYSTEM OF ELECTRIC LIGHTING.

SPECIFICATION forming part of Letters Patent No. 239,152, dated March 22, 1881.

Application filed October 30, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electric Lighting and Translation; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of this invention is to furnish means for controlling a large number of lamps or other electric devices whose current is supplied from a circuit which supplies other devices without interference with these latter other devices. For instance, from the distributing conductors or mains supplying the current for a district, conductors may lead to a large number of street-lamps which it is desired to light and extinguish at certain hours from the central station without interference with the main circuit. This is accomplished by the means shown in the drawing, in which C S is the central station, such as described in prior applications by me made, from which lead the distributing conductors or mains 1 2. From these latter lead branch or multiple-arc circuits 5 and 6, 7 and 8, 9 and 10, 11 and 12, to lamps L L′ L″ L‴, whose number may be greater or less, as desired. In each of these branch circuits is interposed, so as to form a part of the circuit, an armature-lever, as *m m′ m″ m‴*. From the central station leads a circuit, 3 4, controlled by a key, K, in which circuit, at each lamp, is an electro-magnet, as M M′ M″ M‴.

As shown, the multiple-arc circuits to the lamps lead through the back stops of the armature-levers. Then, so long as key K be open, the springs will hold the levers against their back stops and the lamp-circuits will be completed. When it is desired to extinguish the lamps the circuit 3 4 is closed at K, the magnets attract the armatures, and the lamp-circuits are broken so long as the key is depressed.

It is evident that the lamp-circuits may be carried to the front stops and the closing of the circuit 3 4 used to light the lamps; but I prefer the arrangement shown, as being more reliable, the magnets being so constructed as to require but a small current to hold them closed.

It is also evident that the circuit 3 4 may be controlled by a clock, and that a series of clocks placed in multiple arcs may replace the lamps and be governed by the prime clock at the central station, and, further, that many other forms of electrical devices, of which the lamps L L′ L″ L‴ are only a type, may be used and controlled, as here shown.

What I claim is—

The combination, with a main circuit and branch or multiple-arc circuits, and translating devices in the latter, of a controlling-circuit and devices therein controlling or governing the circuits through the translating devices, and means in the controlling-circuit for causing, at will, the controlling or governing devices therein to operate, substantially as set forth.

This specification signed and witnessed this 14th day of October, 1880.

THOMAS A. EDISON.

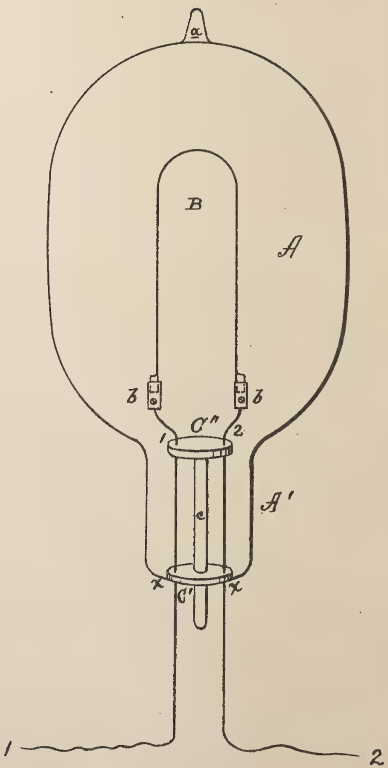
Witnesses:
CHAS. BATCHELOR,
WM. CARMAN.

(Model.) 2 Sheets—Sheet 1.

T. A. EDISON.
Electric Lamp.

No. 239,153. Patented March 22, 1881.

Fig. 1.



Witnesses.

S. D. Mott
James A. Payne

Inventor:

T. A. Edison.
by Dyer & Wilber
Attorneys.

(Model.)

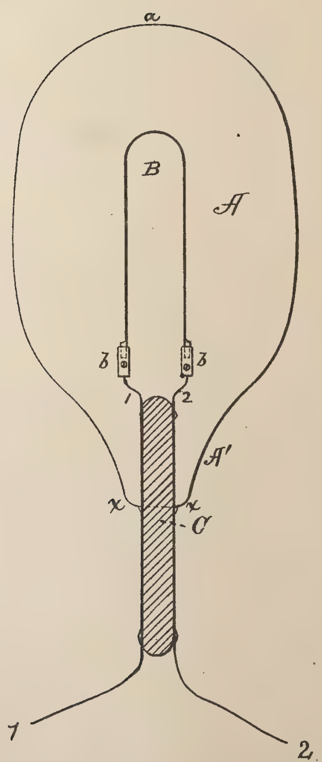
2 Sheets—Sheet 2.

T. A. EDISON.
Electric Lamp.

No. 239,153.

Patented March 22, 1881.

Fig. 2.



Witnesses:

O. D. Mott
James A. Payne

Inventor:

T. A. Edison
by Dyer & Wilber

Attorneys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 239,153, dated March 22, 1881.

Application filed August 27, 1880. (Model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

As is well known, the electric lamp used in my system is a filament of high-resistance flexible carbon inclosed in a hermetically-sealed exhausted glass inclosing-globe, conductors leading to the carbon being sealed into the globe. As these conductors are metallic and good conductors of heat, they may heat to a considerable degree, even to the points where they are sealed into the glass, when, owing to the difference in the rates of expansion of the wire and the glass under heat influences, and the difference in their degree of heat-conductivity, there may be danger sometimes of their separation at the point of union, which would result in the destruction of the vacuum, and, consequently, of the lamp.

In the lamps ordinarily made by me there is a minimum of danger on this score, owing to the fact that by the proper adjustment of the resistance of the carbon an exceedingly small conductor is used.

It may be desirable to still further reduce this danger in such lamps, and also to provide lamps in which larger conductors, either for a greater number of carbons in multiple arc or of lower resistance, may be used with a minimum of danger from the source referred to. This may be accomplished by interposing a larger interval between the clamps of the carbon and the point at which the wires are sealed in the glass inclosing-globe, so that the length of the wire between the two points is such that heat enough to be dangerous will not be conducted through the wire to the point of sealing.

As the carbons are flexible and the conductors, even of the largest size, are so small as to be flexible, it is desirable that the conductors should be supported very near to the clamps, in order to give to the carbons and their supports the necessary stability.

The object of this invention is to furnish a lamp in which the desired results are accomplished; and to that end it consists in the features more particularly hereinafter set forth and claimed.

In the drawings, Figures 1 and 2 are views of lamps illustrating the invention embodied in slightly different forms.

Like letters of reference indicate the same parts in both figures.

A is the glass inclosing-globe, with its lower end fashioned into a neck, A′, left open when first made.

B is the incandescing conductor, of flexible high-resistance carbon, attached to clamps *b b* on the terminals of conductors 1 2.

In Fig. 1, C′ C″ are two glass disks connected by a glass rod or connection, *c*. The conductors 1 2 pass through and are sealed into both disks C′ C″. So sealed, the disks, conductors, and carbon are passed up into the globe, and the open end of the neck A′ is then hermetically sealed to the disk C′ and the globe exhausted in the usual manner. By this means the points of sealing which guard the vacuum are removed to a distance from the source of heat, while the carbons and the conductors are suitably supported.

In Fig. 2 the conductors 1 2 are fastened to a glass rod, C, either along the entire length of the rod or at intervals. The rod, with the attached conductors and carbon, is then passed into the open neck C, which is sealed around the rod at a distance from its upper end, the same results following as in the other case.

What I claim is—

1. The combination, with the glass inclosing-globe and incandescing conductor of an electric lamp, of a support hermetically sealed to the globe and supporting the carbons at a distance above the point of sealing, substantially as set forth.

2. The combination, with the conductors of an incandescent electric lamp, of a glass support to which the conductors are sealed at two or more points, one near the clamps and one where the conductors enter the inclosing-globe, so that the latter point is removed a little distance from the former, substantially as set forth.

This specification signed and witnessed this 11th day of August, 1880.

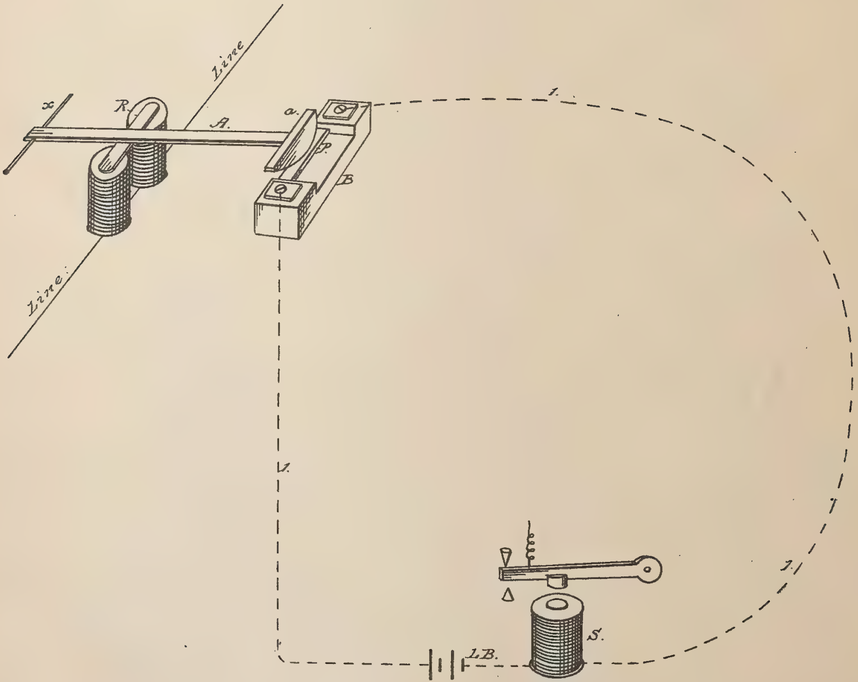
THOS. A. EDISON.

Witnesses:
WM. CARMAN,
OTTO A. MOSES.

(No Model.)

T. A. EDISON.
Relay for Telegraphs.

No. 239,154. Patented March 22, 1881.



Attest;
J. W. Howard
J. A. Hall

Inventor;
T. A. Edison
per Dyer & Wilber
Att'ys

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

RELAY FOR TELEGRAPHS.

SPECIFICATION forming part of Letters Patent No. 239,154, dated March 22, 1881.

Application filed December 14, 1880. (No model.)

To all whom it may concern:

Be it known that I, Thomas A. Edison, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Telegraph Apparatus; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of this invention is to provide a relay for telegraph-lines, in which a sounder or other electrical apparatus in a secondary or local circuit shall be controlled by varying the resistance therein; and my arrangement for this purpose consists in a local circuit containing such a resistance as shall decrease the current, so as not to allow the sounder to be affected thereby until, by the completion of the main circuit, an armature is moved, which brings a better conductor into the place of the resistance, thus causing a stronger current in the local circuit, and operating the sounder placed therein, all as will be more fully hereinafter set forth.

The accompanying drawing represents a form of my invention.

1 is the local circuit, in which is contained a piece, *p*, of carbon or platinum, of high resistance power, but flexible, so as to be easily bent.

L B is the local battery, whose power is such that when the full resistance, *p*, is in circuit the current will be insufficient to operate the sounder S.

R is the relay-magnet in the line-circuit, and A its armature-lever, which is pivoted at *x*, and has attached to its other end the metal piece *a*, the top of which is square or oblong and the lower part curved, as shown in the drawing.

When the main circuit is closed through R, the armature A is attracted and pulled down, so that the piece *a* is pressed against the resistance *p*, which, being flexible, is pressed down in the middle, so that it conforms to the shape of *a*, and a large part of the surfaces are in contact. The current from L B thus passes through *a* instead of *p*, and the resistance being lessened, the current is increased sufficiently to operate the sounder S.

I do not claim, broadly, the method of operating a local circuit, consisting in varying the resistance therein, as such is the subject of a prior application.

What I claim as my invention is—

The combination, with a local circuit and instruments therein, of a flexible high resistance in such circuit, and a metallic contact resting therein and controlled by the main circuit, substantially as and for the purpose described.

This specification signed and witnessed this 11th day of December, 1880.

THOS. A. EDISON.

Witnesses:

H. W. Seely,
Wm. Carman.

(No Model.)

T. A. EDISON & C. BATCHELOR.

Testing Electric Light Carbons.

No. 239,372. Patented March 29, 1881.

Fig. 1.

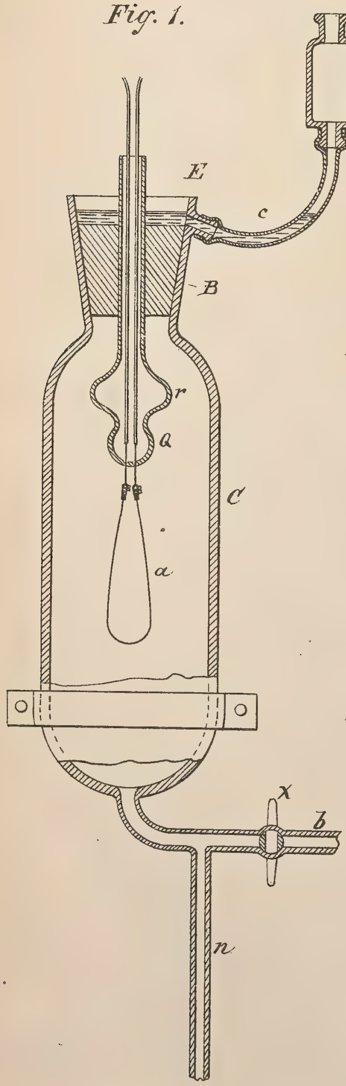
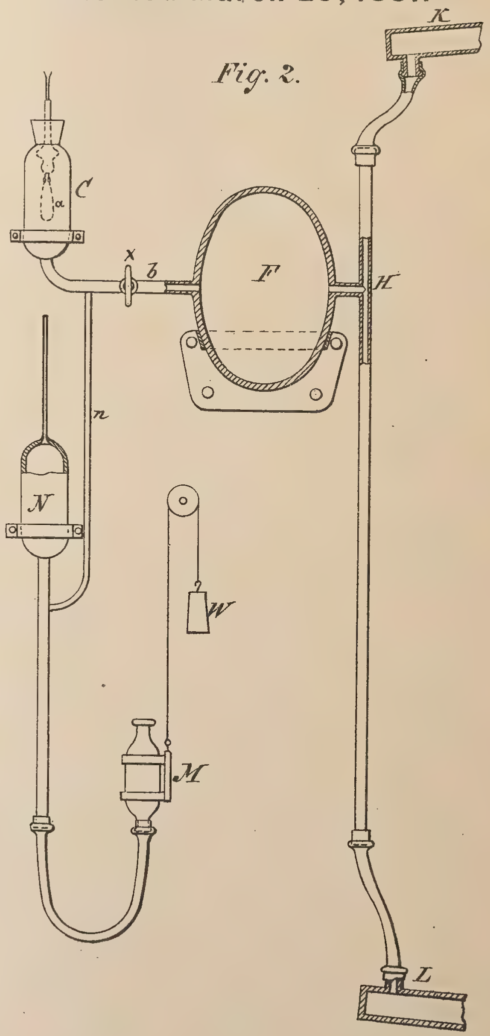


Fig. 2.



WITNESSES:

F. W. Howard,
F. K. Hall.

INVENTORS:

T. A. Edison,
Charles Batchelor,
BY Dyer & Wilber,
ATTORNEYS.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D C

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON AND CHARLES BATCHELOR, OF MENLO PARK, N. J.

TESTING ELECTRIC-LIGHT CARBONS.

SPECIFICATION forming part of Letters Patent No. 239,372, dated March 29, 1881.

Application filed August 9, 1880. (No model.)

To all whom it may concern:

Be it known that we, THOMAS A. EDISON and CHARLES BATCHELOR, both of Menlo Park, in the county of Middlesex and State of New Jersey, have invented new and useful Means and Methods of Testing Electric-Light Carbons; and we do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

As explained in patents hitherto granted T. A. Edison, and also in applications for patents by him made, he uses in his lamps a very small carbon slip or loop, now ordinarily called a "horseshoe-carbon," which is secured in a hermetically-sealed glass vessel, giving light by its incandescence under the action of an electric current.

Hitherto, in manufacturing the lamp, the carbon, having been prepared from paper, wood, or a suitable fiber, was placed in the lamp, whose parts were then sealed. The lamp was then exhausted of air, a current being applied during the process of exhaustion, heating the carbon. Prior to sealing in the lamp and the process of exhausting the completed lamp the carbons were not heated, and prior to heating, any defect therein could not be discovered. It is practically impossible to produce all the loops or slips of absolute uniformity or homogeneity or to carbonize all of them absolutely uniformly throughout their entire mass. When heated to redness throughout their length, some show spots either less red or of a lighter red than the average of the carbon, indicating for the first time faults in the carbons. Where there is a bad fault in the carbon a white incandescence appears, determining the life of the lamp, and also affecting its resistance. Such lamps are unfit for use, and the entire cost of their manufacture has proved a loss.

The object of this invention is to furnish a simple and easy method and means of testing the carbons before they are put in the lamps proper, and so prevent defective or unsuitable carbons from being embodied in completed lamps to be only thrown away upon discovery of the faults, increasing, in fact, the net cost of the faultless ones. This is accomplished by a preliminary heating of the carbons in vacuum, which, by the means hereinafter shown, can be cheaply, rapidly, and effectually done.

In the drawings, Figure 1 is a sectional view of the preliminary proving-lamp, and Fig. 2 is a view of the preliminary proving-lamp and vacuum apparatus complete.

Q is the usual glass carbon-support, which is sealed to the glass globe in the completed lamp at *r*, as set forth in prior patents granted to me. *a* is the carbon to be proved, secured thereto in the usual way.

C is the temporary proving-lamp, having at its upper end an aperture sufficiently large to admit the carbon and its support, and provided with a soft-rubber cork, B, through which the neck of the carbon-support Q passes. The cork B fits tightly in the aperture, the sealing being further rendered secure by a mercury-seal, E, a mercury-reservoir, *d*, being elevated when necessary, so that the mercury therefrom flows down through a tube, *c*, over the top of the cork. From the bottom of the proving-lamp C proceed two tubes, one, *h*, connecting with a McLeod gage, N, provided with a weight, W, for easy handling of the mercury-reservoir M of the gage. The other tube, *b*, leads to and connects with the vacuum apparatus F.

The chamber F is preferably of glass, and of very large capacity compared to that of lamp C—say one hundred times its capacity. Connected to F are several Sprengel drop-tubes, one of which, H, is shown, which constantly maintain a high degree of exhaustion in F.

K is the mercury-reservoir for the Sprengel drops, which, passing through the drop-tubes, collect in the mercury-well L, whence it is pumped back to K.

In operation, the carbon to be tested is placed in the proving chamber or lamp C and the mouth hermetically sealed. The stop-cock *x* in tube *b* is then opened, giving free communication between the chambers C and the exhausted receiver F, whereupon there is an immediate equalization of atmospheric tension between C and F. As F, however, is, say, one hundred times the capacity of C, ninety-nine one-hundredths of the air in F is instantaneously exhausted therefrom, giving ordinarily a degree of exhaustion in C sufficient for the proving of the carbon, the McLeod gage N being used to determine whether such degree of exhaustion

has been reached. If the carbon proves defective, it is discarded, the only loss being the labor and material (which are small) involved in the manufacture of the carbon, and not, as hitherto, the labor and material (which were many times greater) necessary to a completed lamp.

It is evident that the vacuum apparatus herein shown for effecting a speedy exhaustion of the proving lamp or chamber may be used with completed lamps for effecting speedily and economically a partial exhaustion of the lamp-chamber, the exhaustion being then completed by the action of suitable exhaust apparatus directly upon the lamp-chamber.

It is evident that several carbons may be tested at once in the proving-chamber or temporary lamp.

What we claim is—

1. The combination, with a globe or chamber, of a much larger chamber or reservoir connected to air-exhausting apparatus, which maintains therein a high degree of exhaustion, substantially as set forth.

2. The combination of a proving chamber or globe, a mercury-reservoir for sealing the same, and exhaust reservoir or chamber and means for exhausting the same, substantially as set forth.

3. The combination of a globe or chamber, a second and much larger globe, chamber, or reservoir, a valved tube connecting them, means for maintaining a high degree of exhaustion in the larger reservoir or chamber, and connected thereto, and a gage for determining the degree of exhaustion, substantially as set forth.

4. The combination, with the globe or chamber of a proving-lamp, of a mercury-reservoir connected to the globe or chamber, so that the stopper thereof may at will be covered or not covered by mercury, substantially as set forth.

5. The method of testing carbons consisting in subjecting them to the action of a current in a temporarily-exhausted globe or receiver prior to their embodiment in completed lamps, substantially as set forth.

This specification signed and witnessed this 28th day of July, 1880.

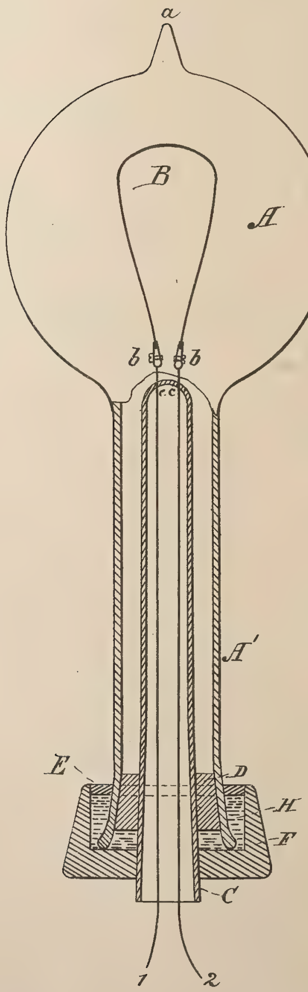
THOS. A. EDISON.
CHAS. BATCHELOR.

Witnesses:
G. E. GOURAUD,
WM. CARMAN.

(Model.)

T. A. EDISON.
Electric Lamp.

No. 239,373. Patented March 29, 1881.



Witnesses:

S. D. Mott

James A. Payne

Inventor:

T. A. Edison.

per Dyer & Wilber

Attorneys.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 239,373, dated March 29, 1881.

Application filed August 17, 1880. (Model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

This invention relates to a new method of manufacturing electric lamps, wherein an incandescing conductor is sealed in an exhausted inclosing-globe; and it consists in the features more particularly hereinafter described and claimed.

In patents hitherto granted me are shown lamps hermetically sealed by a fusion of the glass at the union of the parts, making a permanent lamp of great durability. Sometimes, however, it may be desirable to make a lamp in which a less permanent seal is used, involving a less expensive method of sealing, and which may be taken apart readily for the substitution of a carbon or for other purposes. The drawing (one figure) illustrates such a lamp.

A is the inclosing-globe, made with a long neck, A′, through which may be passed the carbon B, attached to clamps *b b*, connected to conductors 1 2, which are sealed in the top of a tube, C, at *c c*, the tube C being somewhat smaller than the neck A′. Around the base of C is a soft-rubber plug, D, which fits into the lower part of the neck A′, forming a tight joint between the two, supporting C and the carbon in position in A′ and A.

F is a socket or cup, through the bottom of which, by a tight joint, passes the end of C, the end of D resting in the cup. At the top of the cup a washer, E, of soft rubber, fills tightly the space between A′ and the inner wall of the cup F, the space in the cup being filled with mercury H or other suitable liquid.

The lamp so put together is exhausted and then sealed at *a* in the usual manner, the combination of the cup F, plugs or washers D and E, and the mercury H forming a reliable seal.

What I claim is—

The combination, with the neck of the inclosing-globe and the carbon-supporting tube, of a cup containing a liquid receiving the end of the neck of the inclosing-globe, and through which passes the carbon-supporting tube, and washers or plugs filling the space between the neck and cup and the neck and tube, substantially as set forth.

This specification signed and witnessed this 7th day of August, 1880.

THOS. A. EDISON.

Witnesses:

WM. CARMAN,

OTTO A. MOSES.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

Regulating the Generation of Electric Currents.

No. 239,374. Patented March 29, 1881.

Fig. 1.

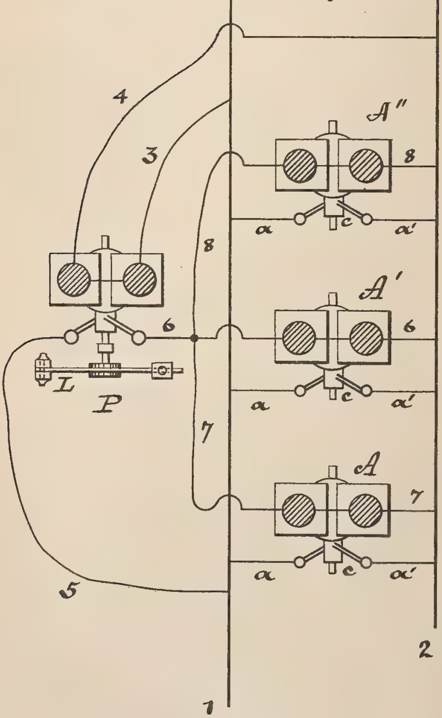
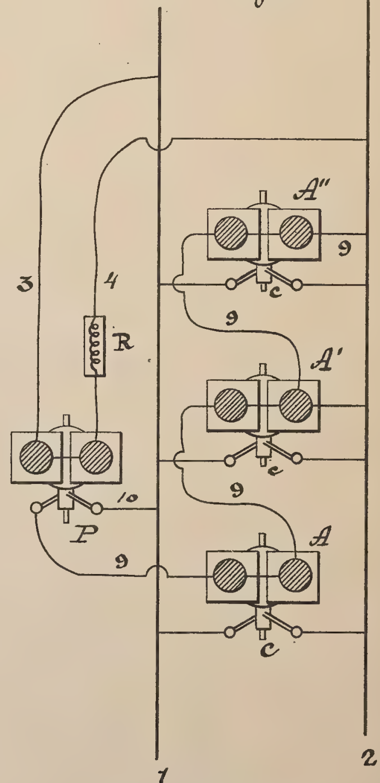


Fig. 2.



Attest:

S. D. Mott

M. J. Hagelt

Inventor:

Thos. A. Edison

Attys.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

Regulating the Generation of Electric Currents.

No. 239,374. Patented March 29, 1881.

Fig. 3.

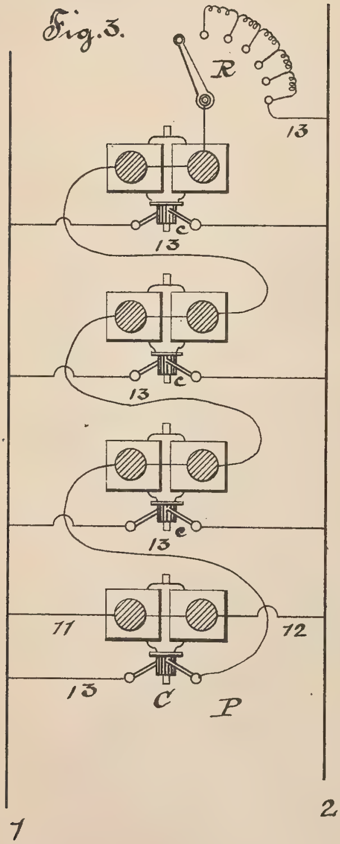
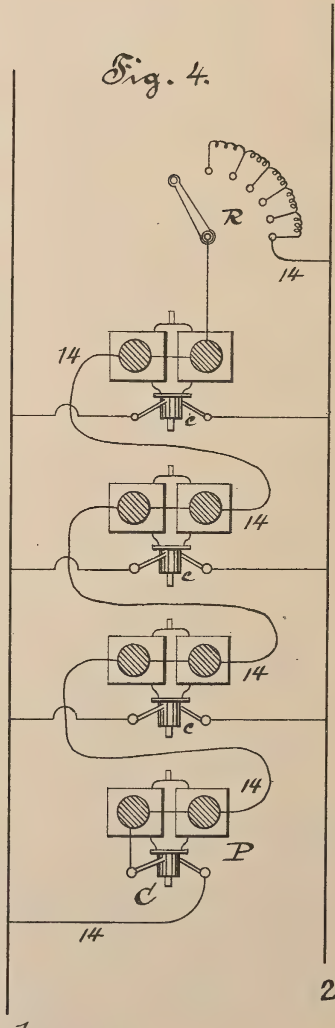


Fig. 4.



Attest
S. D. Mott
M. J. Clagett

Inventor
Thos. A. Edison
Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATING THE GENERATION OF ELECTRIC CURRENTS.

SPECIFICATION forming part of Letters Patent No. 239,374, dated March 29, 1881.

Application filed January 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Method and Means for Regulating the Generation of Electric Currents; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

When a number of generators are used to furnish the current for a system of generation and translation—such, for instance, as shown and explained by me in a prior application for a patent by me made—it is necessary to provide some means for controlling the generation, so that it may be in accord with the demand of the translating devices, which, of course, must vary. Several methods and means for accomplishing this I have shown in prior applications; and the present invention consists in another method and arrangement for accomplishing it.

In the present case the invention consists in combining, with a battery of generators and the main circuit thereof, an electric engine connected in the field-of-force circuit, and arranged to give a counter electro-motive force to that of the current energizing the fields. In such arrangement, as the number of translating devices in circuit lessens, diminishing the work to be done, the generators tend to run at a higher speed. The engine, however, also runs at a higher speed, throwing an increased counter electro-motive force into the field-circuit, weakening the current therein, which, in turn, lessens the magnetic intensity of the field-magnets, causing a diminution of the generated current. If the work to be done increases, the contrary effect is produced.

In the drawings, Figures 1, 2, 3, and 4 represent diagrammatically different arrangements, all, however, containing the arrangement noted.

In these drawings, P represents the engine. In Figs. 1 and 2 its field-coils are in a multiple-arc circuit 3 4 to the main circuit 1 2.

A A′ A″ are the generators, with their armatures connected to the main circuit in multiple arcs by the conductors *a a′*.

In Fig. 1 the engine P is connected by multiple arcs 6 7 8 through the fields of the generators. In Fig. 2 it is connected by 9 through them in series. In either case P is energized as an engine from the main circuit, and the fields of the generators are energized from the same circuit, and the counter electro-motive force which P sends through the fields in opposition to the current therein from the main circuit will be proportioned to the rate of speed given P, which will be proportionate to that of the generators, as all are energized from the same circuit, which is fed by the current from the generators. As the rate of speed of the generators depends upon the resistance in the exterior circuit, as such resistance lessens, the machines tend to run at a higher speed; but the engine P also tends to run at the same increase of speed, sending a greater electromotive force back through the fields of the generators, thereby weakening the current around the fields and lessening the generation. By this method a perfect balancing of forces may be effected.

If desired, the engine itself may be adjusted by increasing or decreasing the work which is given it to do, one method thereof being shown in Fig. 1, where a friction-brake, L, with an adjustable weight, is shown.

In Figs. 3 and 4 the same general arrangement is shown, except that in Fig. 4 P is shown as a pure dynamo, its own current passing through its own field. In these latter arrangements adjustable resistances R are included in the field-circuit, to aid in the regulation when desired.

What I claim is—

1. The method of regulating the generative force of a battery of generators, by causing the current energizing the field-of-force magnets to energize an electric engine whose counter electro-motive force regulates the strength of the current energizing the field-of-force magnets, substantially as set forth.

2. The combination, with a battery of dynamo or magneto electric generators, of an electric engine arranged to throw a current of counter electro-motive force through the field-circuit of the generators, substantially as and for the purpose set forth.

3. The combination, with the engine arranged to give the counter electro-motive force, as described, of a brake or other mechanism, giving the engine a definite but adjustable work to perform, so that the electro-motive force may be regulated, substantially as set forth.

This specification signed and witnessed this 16th day of December, 1880.

THOS. A. EDISON.

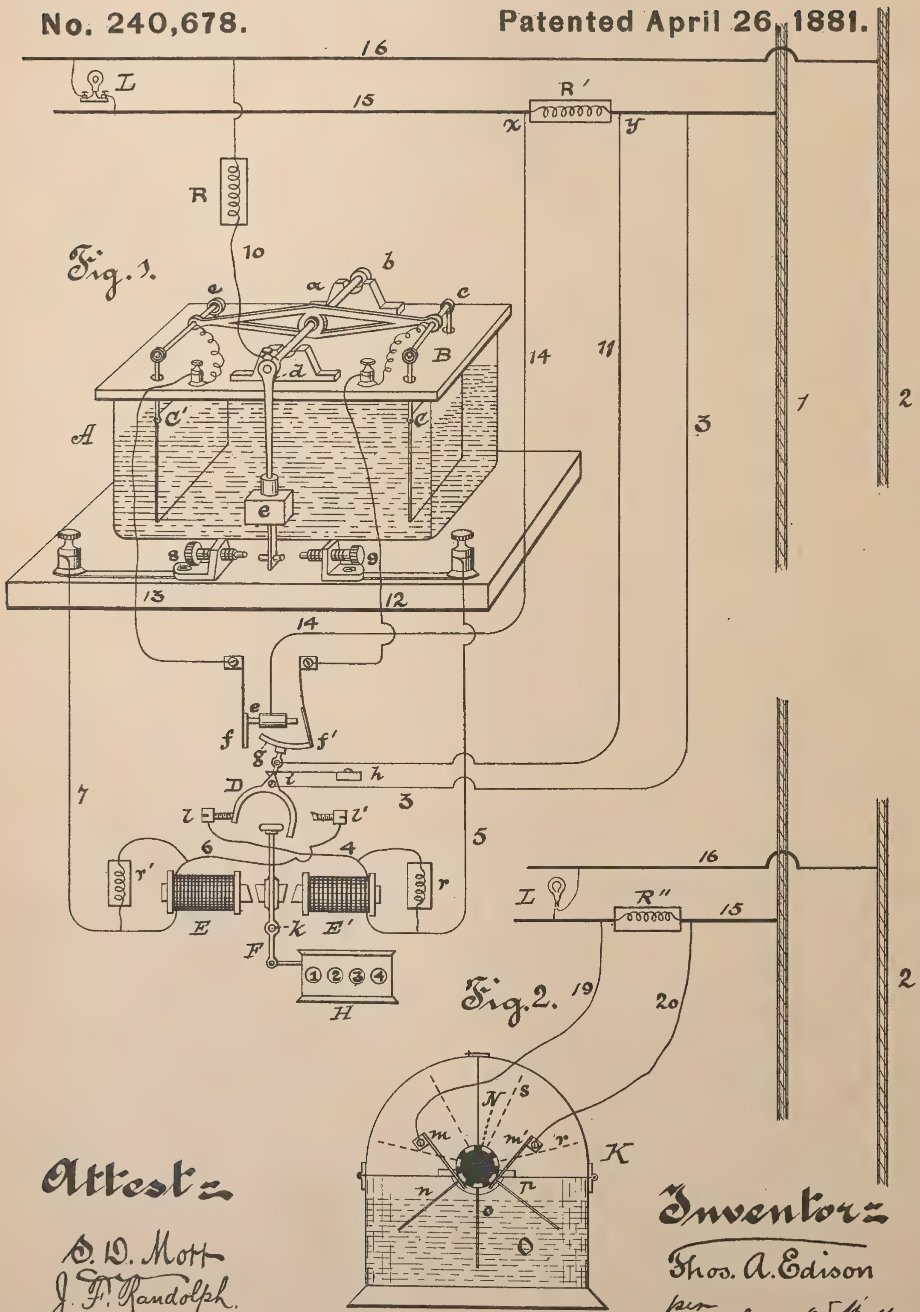
Witnesses:
H. W. SEELY,
ERNEST J. BERGGREN.

(No Model.)

T. A. EDISON.

Webermeter.

No. 240,678. Patented April 26, 1881.



Attest:

S. D. Mott

J. F. Randolph.

Inventor:

Thos. A. Edison

per Dyer & Wilber

Attys.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

WEBERMETER.

SPECIFICATION forming part of Letters Patent No. 240,678, dated April 26, 1881.

Application filed October 7, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Webermeter; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In any system of furnishing to consumers electricity for light, power, or other purposes, it is desirable that means be provided which shall accurately measure the current used. It is also desirable that this measure of current should be automatically indicated and registered in a manner analogous to the registration of gas or water flow.

The object of this invention is to provide means for attaining these results; to which end it consists in the particulars more fully hereinafter set forth and claimed.

A depositing-cell is used in which the plates are suspended but insulated from a balanced arm, to which is attached a lever-arm, on which is a weight adjustable on a lever-arm, so that the amount of excess of weight upon one plate over the other required to cause a tilting of the balanced arm may be determined and regulated. The cell so arranged is placed in a branch circuit—that is, a circuit derived from one member of the circuit supplying the translating devices—resistances being so arranged that a definite fraction of the current used shall traverse the branch circuit and depositing-cell. It is evident, then, that as the weight of one plate is increased by the deposition of, say, copper from the solution, it will tip the balanced arm when the weight of the increase becomes sufficient to overbalance the weight alluded to as on the lever-arm. The lever-arm, moving, causes a movement of a registering apparatus, registering each tip, and at the same time causes a reversal of the current through the cell, the effect of which is that the copper is torn off from the now heavier plate and deposited upon the lighter until it, in turn, becomes the heavier, causing another tipping, another registration, and another reversal. As the amount of current needed to cause the deposition of metal enough to cause the tipping is known, and as it is a definite percentage of the entire current, the registration may indicate the total amount of current; or, as the ratio existing between current and feet of gas for illuminating effect has been determined, the registration may indicate the equivalency in light of feet of gas. As stated, the tipping of the balanced arm and attached lever-arm causes a movement of a registering apparatus and a reversal of the current through the depositing-cell. It may cause this directly by having either the balanced or the lower arm connected directly to a register and to a reverser, or indicated by setting into operation intermediate mechanism. In the latter case the following is a convenient arrangement: Two magnets are used with their poles placed oppositely, between which plays an armature-lever, one end of which is attached to the prime motor of the register, the other end playing in the open part of a fork or Y, whose upper end operates a reverser. The play of the Y is limited by two set-screws, one on either side, with a circuit-connection from each to one of the magnets, the connection from the left-hand screw being to the right-hand magnet and from the right-hand screw to the left-hand magnet. The play of the weighted lever-arm, before referred to, is determined by two set-screws, each screw being connected with the magnet upon its side.

From one member of the circuit containing translation devices is a circuit-connection to the Y, while the lever-arm is connected to the other member. In this circuit is interposed a very large resistance, so that but a small percentage of the current passes therethrough, simply enough to operate an ordinary electro-magnet. A circuit then may be formed through either magnet, in which are two breaks, one closed by the weighted lever at the end of its movement, the other by the Y at the end of its movement, the circuit being shifted from one magnet to the other as the lever-arm is tipped by the plate receiving its determined load by deposition. Around each magnet is a short circuit of large resistance, which affords a path for the extra or induced current, avoiding spark therefrom at the contact-points. The same principle—namely, the effecting of a registration by the overweighting of a plate by deposition—may also be carried into effect

by mounting upon a shaft a series of plates which radiate therefrom. This shaft is journaled in a suitable case, which is filled with the proper depositing-solution nearly up to the shaft. Upon the shaft are a series of commutator-blocks, one for each plate. Commutator-springs are so arranged as to bear simultaneously upon the blocks of the plates remote from each other in the fluid, a branch circuit from one member of the consumption-circuit being connected to the springs. As deposition proceeds one plate becomes so loaded as to cause a partial rotation of the shaft, which causes the circuit to be formed through another plate, which, becoming loaded, causes further rotation, bringing another plate into the circuit, whereupon the first plate is again in circuit, but in such relation as to be the plate which is reduced to afford material for deposition upon the other plate in circuit, each plate being thus successively loaded and stripped, the movement from one pole to the other, caused by loading the deposition, being registered by the rotation of the shaft.

The invention may be carried into effect in many other ways; but the ones here described are sufficient to illustrate its principle.

Instead of a balanced arm from which the plates are suspended, a spring-balance may be used, the plate, as it becomes loaded, acting on a spring to make the necessary circuit-connections at the predetermined point.

In the drawings, Figure 1 is a view, partly perspective, showing the form first described, while Fig. 2 is a second plan or modification.

In Fig. 1, A is any suitable containing-cell, provided with a cover, B, upon which is a balanced arm, *a*, attached to a shaft, *b*, pivoted in suitable bearings or supports attached to the cover. From the ends of the arm *a* are suspended the plates C C′, forming the anode and cathode of the cell. Upon the end of *b* is a lever-arm, *d*, upon which slides the weight *e*, provided with means for securing it in any desired position. At its lower or free end *d* is provided with contact-points, which take against the set-screws 8 9, which limit its motion.

E E′ are two electro-magnets, whose poles face each other, acting upon armatures upon a lever, F, pivoted at *k*, playing between the two magnets, and so connected at its lower end with a register, H, as to operate it upon each vibration of the armature-lever. At its upper end F takes between the limbs of the fork D, pivoted at *i*, to whose upper end is attached an arm, *g*, taking between contact springs or levers *f f′*, which, in connection with *e*, form a reverser.

h is a small spring, having a projection at its end taking over a small projection upon D with sufficient force to hold it against accidental displacement.

1 2 are the main conductors of a system from which lead conductors 15 16 to and through the place of consumption. From 15 a circuit is formed through the depositing-cell by 11 *g* *f′* 12 C C′ 13 *f e* 14, the direction of the current in the cell being determined by the contacts of *f*, *f′*, and *e* in the reverser. Between 11 and 14 in 15 a resistance, R′, is placed, adjusted to cause a definite and determined fraction of the entire current traversing 15 to pass through the cell.

A circuit for the magnets E E′ is formed as a derived or multiple-arc circuit to 15 16 by 3 D, and then in one position of D, by *l* 4 E′ 5 9 *d* 10, to 16, or in another position of D, by 3 D *l′* 6 7 8 *d* 10, to 16.

In 10 a resistance, R, is placed, adjusted to the resistance of the main circuit, so that only a small amount of current, simply enough to make E or E′ effective, shall traverse the circuit through them.

Short circuits around E E′ are formed, containing resistance *r r′*, for the purpose of absorbing the extra or induced current, lessening or avoiding spark at the contact-points.

The operation is as follows: Suppose the parts to be in the position shown in Fig. 1, and the current flowing through the cell, so that C is the anode and C′ the cathode. As metal is deposited upon C′ it gradually overbalances C, swinging *d* out of the perpendicular, until finally it takes against screw 9, whereupon the circuit through E′ is closed *via* 10 *d* 9 5 4 *l* D 3. E′ attracts F, causing it to operate the register H. F, in moving toward E′, strikes D, causing it to break circuit at *l* and carrying it over against *l′*. At the same time the arm *g* is carried in the reverse direction, leaving *f′* and allowing it to contact with *e*, and at the same time contacting with *f*, and causing it break contact with *e*, causing the current to pass through the cell in the reverse direction. C′ now becomes the anode, and the metal deposited thereon is dissolved therefrom and carried to C, which, finally becoming the heavier, causes a repetition of the operations described.

It is evident that the reverser and register might be actuated directly by *d;* but the devices shown are more accurate and delicate, and destructive sparks at the contacts are greatly lessened, if not entirely obviated.

In Fig. 2, K is any suitable case, in which rotates a shaft from which project radial plates *n o p*, &c., dipping into the fluid O. The plates are insulated from each other and each is attached to a commutator-block. *m m′* are commutator brushes or springs, arranged to bear upon the blocks of the plates remote from each other in the fluid. To *m m′* lead conductors 19 20, completing a branch circuit from the house or consumption circuit. Suppose the current to flow in such direction that *n* is the anode and *p* is the cathode, as *p* becomes loaded it sinks in the fluid, causing N to rotate, which movement is registered upon a register attached thereto. This movement has brought *o* in contact with *m*, making it the anode, and *r* in contact with *m′*, making it the cathode. When *r* becomes loaded it causes a rotation, when *p* becomes the anode and *s*

the cathode, whereupon the metal formerly deposited thereon is dissolved off. In both forms each plate is alternately an anode and a cathode, receiving a deposit only to have it stripped off, the very act of deposition setting in operation agencies which cause the change from anode to cathode and agencies which register the change.

The register H may be made so as to indicate webers or current-units, or, as the relation between current and gas for light-production is known, it may indicate the number of feet of gas, which would be equivalent in light-production to the amount of current registered.

While these devices are shown in a branch circuit, so that only a portion of the current passes therethrough, it is evident that they may be placed directly in the circuit.

While the circuits controlling the mechanical devices are here shown as branch or multiple-arc circuits, it is evident that they may be battery local circuits.

It is also evident that all the mechanical devices may be actuated by clock-work which is controlled by the balanced arm or lever.

As this arrangement registers the exact number of webers or current-units passing therethrough, I have applied to it the term "webermeter."

What I claim is—

1. In an electro-depositing cell, the combination, with the plates therein, of means for changing the anode and cathode relation of the plates, substantially as set forth.

2. The combination of a decomposing-cell, balanced polar plates therein, and a registering apparatus controlled by the overloading of either plate, substantially as set forth.

3. The combination of a decomposing-cell, balanced polar plates therein, and a reverser reversing the direction of the current through the cell, and controlled by the overloading of either plate, substantially as set forth.

4. The combination of a decomposing-cell, balanced polar plates therein, and registering apparatus, and means for reversing the direction of the current through the cell, the register and reverser being controlled by the overloading of either plate, substantially as set forth.

5. The combination, with a main circuit, of a shunt or branch circuit through which passes a definite portion of the current, a depositing-cell containing balanced plates, a register, and a reversing apparatus, substantially as set forth.

This specification signed and witnessed this 22d day of September, 1880.

THOS. A. EDISON.

Witnesses:

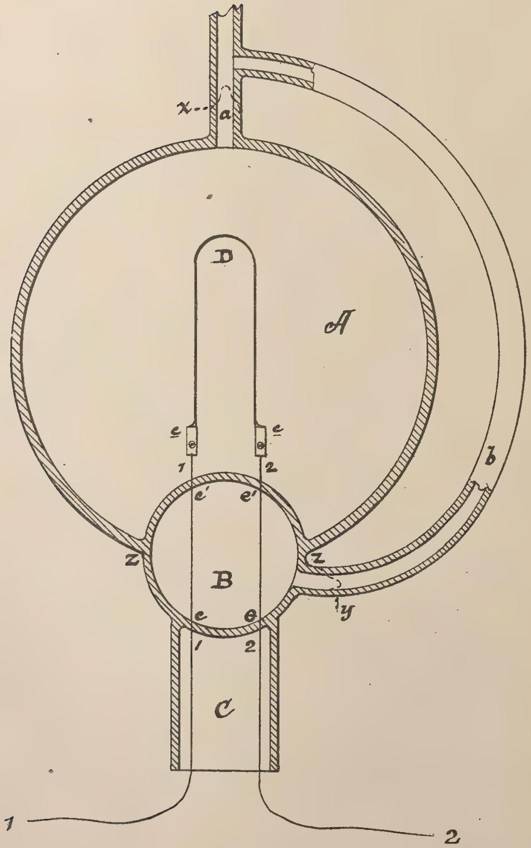
W. CARMAN,

S. MOTT.

(No Model.)

T. A. EDISON.
Electric Lamp.

No. 239,745. Patented April 5, 1881.



Witnesses:
S. D. Mott
James A. Payne.

Inventor:
T. A. Edison.
per Dyer and Wilber
Attorneys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 239,745, dated April 5, 1881.

Application filed August 17, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

In electric lamps formed by sealing an incandescing conductor hermetically in a glass inclosing-globe, there may be danger, sometimes, that the glass and wire will separate at the point where the conducting-wires pass through and are sealed into the glass globe. This is due to the fact that the conducting-wires, near the incandescing material, become very hot by conduction, and that the coefficient of expansion of the glass and wire are so different.

In the lamps made on my plans, owing to the high resistance of the incandescing material, such small conductors are used that the danger referred to has been of minor or the very least importance. It may be desirable, however, to provide means which reduce the danger to a minimum, while affording, at the same time, the necessary support for the very small and delicate conductors and incandescing material.

The object of this invention is to provide such means; and to that end it consists in the features more particularly hereinafter set forth and claimed.

The drawing shows a lamp involving my invention.

A is the glass inclosing-globe, formed with tube *a*, for attachment to the exhausting apparatus. A smaller bulb, B, is made attached to the supporting-neck C, and formed with a tube, *b*. Through the bulb B the conductors 1 2 are passed and sealed therein, 1 being sealed at *c c'*, and 2 at *e e'*. The bulb B is then sealed into A, at the line *z z*, and the tube *b* connected to the tube *a*, the bulb B practically forming the seal to A. The tube *a* is then connected to the exhaust apparatus. It is evident that a vacuum is created in both A and B. When a proper degree of exhaustion is reached the tube *b* is sealed off at *y*, after which the tube *a* is sealed off at *x*. The vacuum in globe A is thus protected by two sealings of each wire, *c e* and *c' e'*, to only one set of which is there any danger, *c' e'*, the other set, *c e*, from its distance from the heated portion of the lamp, never heating sufficiently to be affected.

As very small conductors are used it is necessary, for stability, that they be supported near the carbon, which is done at the sealings *c' e'*; but if either of these, from their proximity to the light, is ever so heated as to crack, it will still subserve its function as a support, while the vacuum is preserved by the seals *c e*.

What I claim is—

1. In an electric lamp, the combination, with the inclosing globe or chamber, of a second chamber, through and into which the conducting-wires pass and are sealed, both chambers being hermetically secured together and exhausted, substantially as set forth.

2. The method of sealing the inclosing globe or chamber of an electric lamp, by sealing an exhausted auxiliary or secondary globe or chamber in the opening of the first or inclosing globe, substantially as set forth.

3. The method of preserving the vacuum in the inclosing-globe of an electric lamp, consisting in sealing the conducting-wires at two points in a vacuum-globe hermetically sealed to the inclosing-globe, substantially as set forth.

This specification signed and witnessed this 7th day of August, 1880.

THOS. A. EDISON.

Witnesses:
WM. CARMAN,
OTTO A. MOSES.

(No Model.)

T. A. EDISON.

Incandescent Electric Lamp.

No. 242,896. Patented June 14, 1881.

Fig. 1.

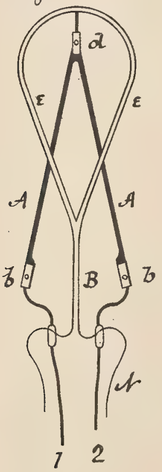


Fig. 2.

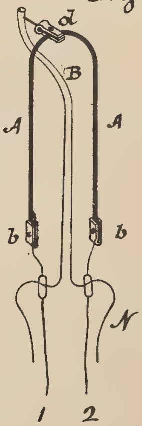


Fig. 5.

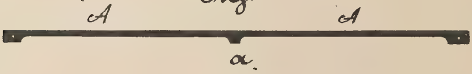


Fig. 4.

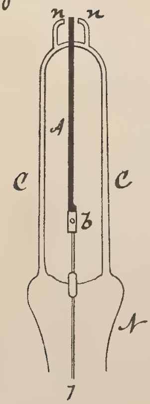
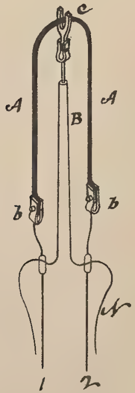


Fig. 3.



Attest:

S. D. Mott

F. W. Howard

Inventor:

Thos. A. Edison

per Dyer & Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 242,896, dated June 14, 1881.

Application filed December 15 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescent Electric Lamps, (Case No. 269;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In the use of that class of incandescent electric lamps in which the carbon consists of a filament bent into a horseshoe shape and having its ends secured in clamps, difficulty is sometimes experienced from the carbon bending and falling over.

The object of my invention is to obviate this difficulty by constructing a device which will hold the carbon in an upright position; and to this end my invention consists in employing a supporter made of glass or other insulating material, having a support at its upper end, by which the carbon loop is held erect.

In the accompanying drawings, Figures 1, 2, and 3 are front views of different forms of my device; Fig. 4, an edge view of one form, and Fig. 5 a view of a carbon which may be used.

1 2 are the wires passing through the glass N and terminating in the clamps *b*. In each of these clamps is inserted one end of the carbon A A, which is bent into a loop. The glass N is continued upward in the form of a long stem, B, as in Figs. 2 and 3, which has attached to its end a suitable device for holding the carbon erect.

In the form shown in Fig. 2 a projection extends out laterally from near the top of the stem B, and carries the clamp *d*, made of platinum or other suitable metal not easily affected by the current, in which is inserted the loop of the carbon A A at the point *a*. With such construction it is preferable to construct the carbon with an enlarged part, as shown at *a*, Fig. 5, in order to give a larger bearing-surface for the clamp *d*.

In Fig. 3 the stem B is shorter and is not bent, and the projection extends directly upward from its top. The clamp at the end of this projection holds the Y-shaped piece *c*, preferably of platinum, between the prongs of which the carbon loop passes, and is thus kept from falling over sidewise.

In the form shown in Fig. 4 a loop of glass, C C, extends upward, being placed at right angles with the carbon loop. The projections *n n*, extending upward from the glass loop, are arranged one on each side of the carbon, and so keep it from bending or falling. In Fig. 1 the carbon is differently formed, extending up from the clamps in straight lines meeting at *d*. The stem of glass B extends up between the carbons a short distance, and then branches off into a loop, *e e*, which passes around above the point of junction of the carbons, and directly above this point a glass stem projects downward, having on its end the clamp *a*, which holds the ends of the carbons.

What I claim is—

1. The combination, with the incandescing loop of an electric lamp, of a support arranged to maintain the carbon loop in its normal position.

2. The supporting-neck in which the wires leading to the loop are sealed, provided with an arm for maintaining the loop in its normal position, substantially as set forth.

This specification signed and witnessed this 3d day of December, 1880.

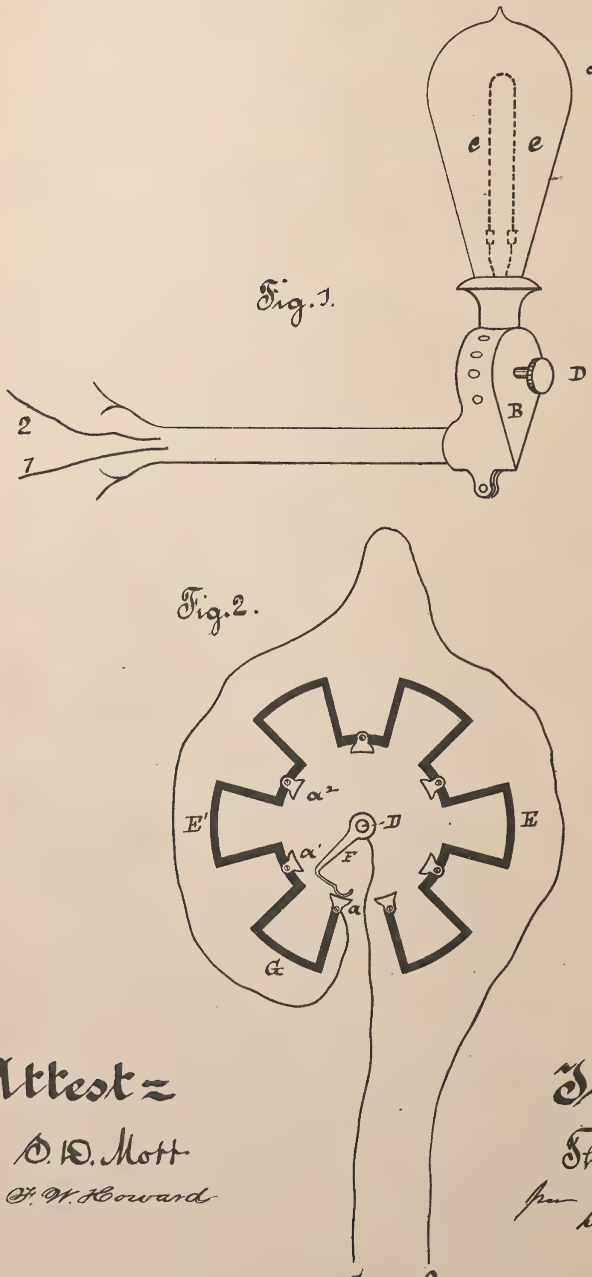
THOS. A. EDISON.

Witnesses:
H. W. SEELY,
S. D. MOTT.

(No Model.)

T. A. EDISON.
Incandescent Electric Lamp.

No. 242,897. Patented June 14, 1881.



Attest:
O. D. Mott
F. W. Howard

Inventor:
Thos. A. Edison
per Dyer & Wilber
Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 242,897, dated June 14, 1881.

Application filed December 15, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescent Electric Lamps, (Case No. 267;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to furnish a device by means of which the light of a single lamp of an electric-lighting system may be increased or diminished without affecting any others of the series; and to this end my invention consists in the interposition in the circuit of the lamp of a resistance the force of which may be varied at the will of the operator by simply turning a key.

In the accompanying drawings, Figure 1 is a view of an incandescent electric lamp in which this invention is used; Fig. 2, a detail view of the resistance.

1 2 are the wires of an electrical circuit passing up through the base of the lamp to the carbon C C, A being the globe in which the carbon is contained.

In order to better adapt the lamp for use as a "night-lamp," this globe may be of ground glass, or of milk or opaque glass, in order to soften and dim the light more effectually.

B is the hollow base which supports the lamp and contains the resistance E E′, Fig. 2. This resistance is of the shape shown, and is made of stiff heavy carbon. Attached to it at various points are metallic contacts a a' a^2, &c. The wire through which the current passes to the light extends to the metal hook F in the center of the resistance. The current thus normally passes through the wire 1, the metal hook F, the contact a, and around through the carbon C C to the wire 2; but if it is desired to decrease the force of the light the hook F may be turned back until it reaches the contact a', thus requiring the current to pass through the portion G of the carbon resistance and interposing so much additional resistance in the circuit. If a still further diminution of the light is required, the hook may be turned back to the contact a^2, and the resistance thus doubled, and so on until the whole of the carbon E E′ is included in the circuit 1 2. For convenience of manipulation, the key D projects out and terminates in a thumb-screw, so that the hook may be easily turned.

E E′ being made, as stated, of carbon, furnishes a considerable resistance to the passage of the current, and as each succeeding section is placed in circuit the force of the current is decreased and the brilliancy of the light correspondingly diminished, and as the key is again turned back the resistance decreases while the light increases.

What I claim is—

1. The combination, with the incandescing conductor of an electric lamp and the key for controlling the circuit thereof, of an adjustable resistance located within the base of the lamp and cut in or out of the circuit in any desired proportion by the key, so that the lamp may be used at any desired power less than its normal capacity, substantially as set forth.

2. A carbon resistance made substantially as described, and provided with a series of metallic contacts, in combination with a key having an arm for completing circuit at any desired contact, substantially as set forth.

This specification signed and witnessed this 3d day of December, 1880.

THOS. A. EDISON.

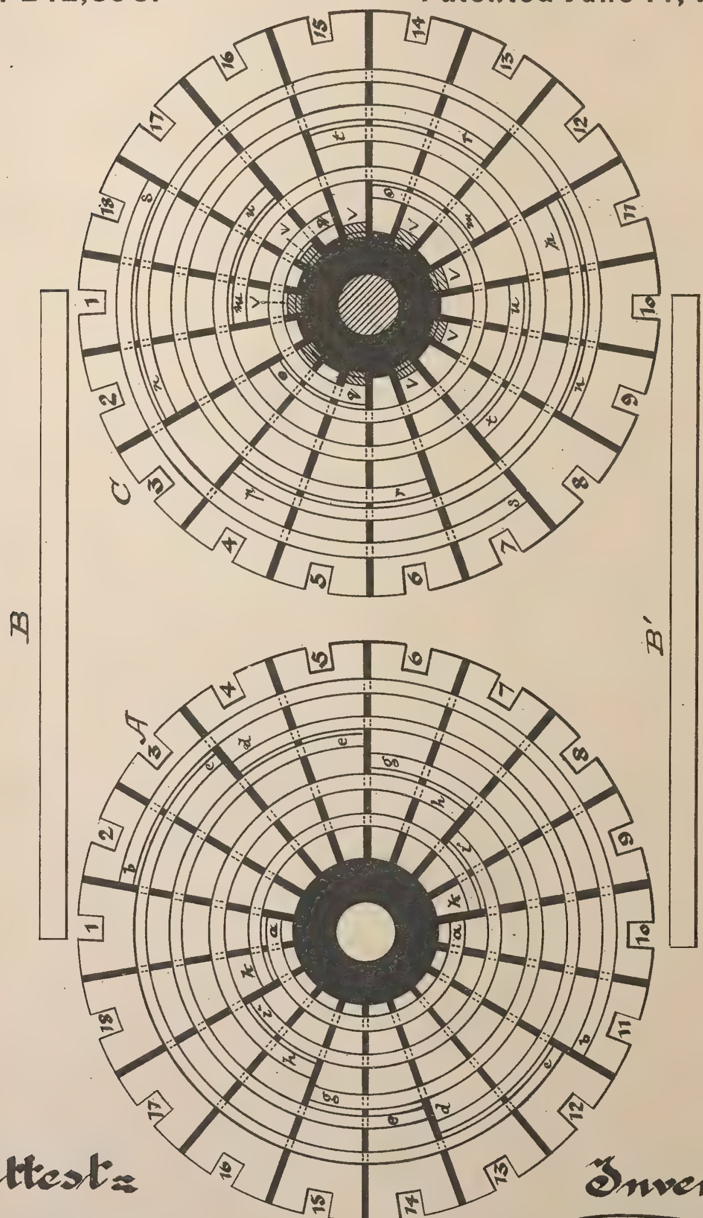
Witnesses:
H. W. SEELY,
S. D. MOTT.

(No Model.)

T. A. EDISON.

Magneto or Dynamo Electric Machine.

No. 242,898. Patented June 14, 1881.



Attest:

S. D. Mott

Chas. P. Hughes.

Inventor:

Thos. A. Edison

per Dyer & Wilber

Attys.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MAGNETO OR DYNAMO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 242,898, dated June 14, 1881.

Application filed December 15, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented certain new and useful Improvements in Magneto or Dynamo Electric Machines, (Case No. 266;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

In that class of magneto or dynamo electric machines in which the revolving armature is composed of a cylindrical core whose surface is partially or entirely covered with coils wound parallel to the axis of the armature the coils cross each other at the ends, so that there is a large mass of wire upon the ends useless for the purposes of generation, while interposing unnecessary internal resistance in the machine, and at the same time being in position for excessive accumulation of heat. These masses of wire, crossing each other at the ends, render repairs to any coil exceedingly difficult, for the repair of any one coil involves the unwinding of such coils as may overlap it upon the ends.

One object of this invention is to construct the revolving armature so that these defects are remedied, to which end this portion of the invention consists in fixing upon insulating-disks which are to be secured to the ends of the armature metal plates or bars corresponding in number to the number of coils or conducting-bars; or if a coil be considered as consisting of the two active wires or assemblages of wires exactly opposite to each other upon the face of the armature, then the number of plates is double that of the coils. These bars are arranged upon the disks as spokes from a hub, radiating from the center, and may be termed the "radiating" plates or bars. These plates or bars are electrically joined in pairs or couples by circular metallic conductors permanently fixed upon the insulating-disks, care being taken to insulate these circular joining conductors from each other. This arrangement of radiating bars or plates and joining conductors takes the place of the wires which formerly crossed the ends. The radiating plates or bars are provided at their outer edges with recesses, in which the active generating metal, whether in the form of wires, strips, ribbons, or bars, may be secured by soldering or by screws, or they may be secured together in any other suitable way.

The construction of revolving armatures as ordinarily practiced, especially in the case of very large machines, requires the use of a large amount of insulated wire. This is expensive, and besides takes up room and allows of the accumulation of heat, owing to the non-conductor forming the insulation, to remedy which is another object of this invention, to which end I use rigid naked bars or wires of proper material, which are so disposed about the armature that each is separated from the others, there being between them an insulation partly of mica and partly of air, which suffices in practice for insulation, and in addition allows such access of air to all the active parts of the armature that danger of heating thereof by accumulation is greatly lessened.

In dynamo or magneto electric machines it is often desirable to give considerable electro-motive force to the generated current, while at the same time there is maintained a low degree of internal resistance of the machine.

Another part of the invention relates to the accomplishment of this, and consists in so arranging the coils or bars and the commutators that all the coils or bars are always in circuit, so that an electro-motive force due to the entire length of all the coils is obtained, and at the same time that part of the conductors which does not set up an electro-motive force within the circuit is made of lower resistance by means of the circular and radial bars or plates at the ends than the portion in which the electro-motive force arises.

The entire invention may be carried into effect by means substantially such as shown in the drawing, wherein C is the commutating end and A the other end of an armature.

Upon suitable insulating bases circular in form the radial metal plates numbered 1 to 18 in A and C are secured, insulated from each other, as indicated, by the blank space between them. Upon A the circular plate or bar *a* connects 1 and 10; *b*, 2 and 11; *c*, 3 and 12; *d*, 4 and 13; *e*, 5 and 14; *g*, 6 and 15; *h*, 7 and 16; *i*, 8 and 17; *k*, 9 and 18. Each of these bars is insulated from the other and from all the plates excepting those which it is designed to

connect. It will be noticed that upon this end the circular bars connect exactly opposite coils, as would the wires ordinarily used. Upon the commutating end C the arrangement is somewhat different. Upon it 1 and 12 are connected by *m*, 2 and 9 by *n*, 3 and 14 by *o*, 4 and 11 by *p*, 5 and 16 by *q*, 6 and 13 by *r*, 7 and 18 by *s*, 8 and 15 by *t*, 10 and 17 by *u*. These bars are insulated, as before stated in the case of A. Upon the commutating end the odd-numbered circular bars are bent outwardly at a right angle at their inner end, the bent portions *v v* being secured to a hub and forming the commutator. To these end disks thus constructed are secured wires, ribbons, or bars in any suitable manner, forming with the radial and circular plates the coils.

For large machines I prefer to use naked bars of copper, B B′, which are secured in the recesses shown in the outer edges of the radial plates. They will be sufficiently insulated from each other by the air space between them. If bars are used not sufficiently rigid to preserve their relative distances from each other throughout their length, stays or blocks of insulating material—such as mica—may be placed between them at proper intervals.

By the arrangement of connections and the commutator, as shown in C, all the coils are constantly in circuit, the generated current having the electro-motive force of a coil of the total length of all the coils, while the internal resistance is kept low by the lessening of resistance in the ends due to the much larger mass of conductor in section of the plates and bars over that of the wires ordinarily used, while the resistance of the active parts, when bars are used, as described, is also greatly lessened.

Supposing the parts are in such position that the commutator-brushes are in connection with 5 and 15, the path of the generated currents will be as follows: starting, say, at the brush on 5, the path in the machine to 15 would be, for one portion of the current *via* 5 *e* 14 *o* 3 *c* 12 *m* 1 *a* 10 *u* 17 *i* 8 *t* 15, and for the other portion *via* 5 *q* 16 *h* 7 *s* 18 *k* 9 *n* 2 *b* 11 *p* 4 *d* 13 *r* 6 *g* 15, thus including every coil.

What I claim is—

1. A revolving armature for magneto or dynamo electric machines having its generative portion composed of coils or bars placed longitudinally upon the core and parallel with its axis of rotation, and having its ends formed of radial plates, one for and connected to each coil or bar, substantially as set forth.

2. The combination, in an armature for magneto and dynamo electric machines, of radial plates and circular connecting-plates, substantially as and for the purpose set forth.

3. An armature for dynamo or magneto electric machines having ends formed of conducting-plates, arranged as described, and with its active or generative portions removably attached to the plates, substantially as set forth.

4. An armature for dynamo or magneto electric machines having its active or generative portions made of naked bars or ribbons of metal, substantially as and for the purpose set forth.

This specification signed and witnessed this 11th day of December, 1880.

THOS. A. EDISON.

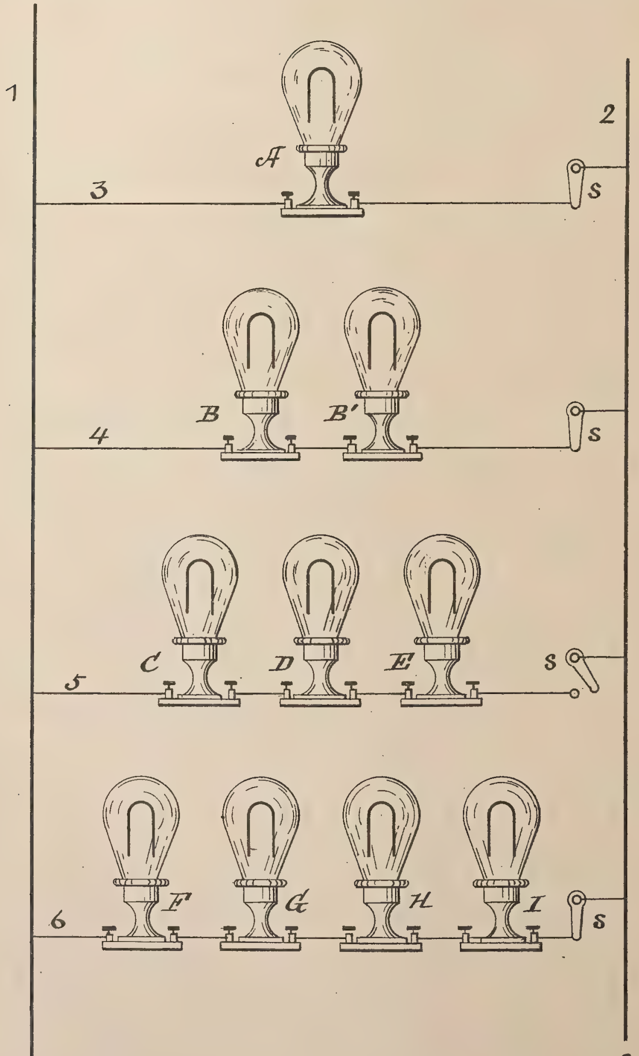
Witnesses:
H. W. SEELY,
WM. CARMAN.

(No Model.)

T. A. EDISON.

Electric Lighting.

No. 242,899. Patented June 14, 1881.



Attest:

D. D. Mott

H. W. Howard

Inventor:

T. A. Edison

per

Dyer and Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LIGHTING.

SPECIFICATION forming part of Letters Patent No. 242,899, dated June 14, 1881.

Application filed January 26, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lighting, (Case No. 287;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

It is now well known that in my system of electric lighting lamps are used consisting of an exhausted glass globe, in which is hermetically sealed to conducting-wires passing through the glass a carbon filament, which is heated to incandescence by the electric current. In every system a lamp is adopted as a standard—that is, one having a definite area of radiating-surface and a definite resistance—so that with a current of a definite electro-motive or pressure force the standard candle-power of light shall be given by a definite amount of energy for each lamp. All the lamps used in the system being made to approximate the conditions of the standard, an approximately uniform result is attained. In such a system each lamp is placed in its own separate derived or multiple-arc circuit, and experience has shown that a lamp giving a light equal to about a sixteen-candle-power gas-jet is the best adapted to average general use. In a patent granted me March 22, 1881, No. 239,150, is shown how more than one lamp may be placed in each multiple-arc or derived circuit. In such system, however, each lamp of the series is of a definite fractional value photometrically only of the standard lamp. It is desirable, however, sometimes to connect in one multiple-arc or derived circuit a series of lamps, each giving the same amount of light as the standard lamp of the system—say sixteen or eighteen candle-power—so that all the lamps in such a circuit—say a chandelier-circuit—could be controlled by one circuit-closer.

The object of this invention is to furnish a method and means for accomplishing this result.

To this end it consists, generally speaking, in making the density of the carbons, where a series of lamps are to be used, proportionately greater than that of the standard lamp, their conductivity increasing and resistance decreasing proportionately, so that with the standard amount of energy the standard electro-motive or pressure force each lamp of such series shall give the standard amount of light, the radiating-surface of each remaining approximately at the area of radiating-surface of the standard lamp.

The proportions in which the density or conductivity must be increased and the resistance diminished, when it is desired to connect a series of lamps in one multiple-arc or derived circuit of a system, may be expressed approximately by a fraction whose numerator is one and whose denominator is the square of the number desired to be so connected.

The drawing represents, diagrammatically, a number of multiple arc circuits.

1 2 are the main conductors. 3, 4, 5, and 6 are multiple-arc circuits. In 3 is shown one lamp which would have the standard conditions of the system. In 4, 5, and 6 two, three, and four lamps, respectively in series, are shown.

Applying the rule before stated, the density of the carbons in B B′ should be such that their resistance is one-fourth that of the standard A, while the resistance of the three in circuit 5 and the four in circuit 6 should be one-ninth and one-sixteenth that of A, respectively. By thus changing this one condition of the standard of the system, radiating-surface and electro-motive force remaining unchanged, it is possible to place in one multiple-arc a series of lamps, each giving the standard candle-power of light, and all capable of being controlled by one circuit-closer, which is typified by S in each of the multiple-arc circuits, but which may be placed in any desired and convenient position for operation. It is evident, though, that when desired a circuit controller or key may be placed at each lamp and arranged so that the operation of any one shall control all the lamps in the circuit. From this it appears that the condition to be changed is the density or mass of the incandescent conductor. This may be effected in several ways. For instance, standard carbons may be taken and carbon deposited therein from carbon vapors by heat, in the manner well known from the researches and experiments of Berthallel

upon the deposition of carbon from carbides of hydrogen and other decomposible carbon compounds until their density be so increased that their resistance is brought down to the desired degree.

Carbons may be dipped in sirup or other carbonaceous material and then recarbonized, the process being repeated until the desired density is attained, and the number of dippings or soakings in a solution of a given strength and recarbonizations to produce a definite result may be accurately determined, so that this process may be carried on with great certainty.

Where very dense carbons of great electrical conductivity are required they may be made of graphitic carbon, sometimes called "plumbago," molded under great pressure; or they may be cut by a punch and die from a sheet of molded graphite of proper thickness.

It is evident that the density or mass and resistance may be varied in many other ways, any of which may be used in practicing this invention.

It is also evident that for the result of increased conductivity for the purposes herein set forth an increase in area of cross-section is equivalent to increase of density, though the latter is preferable unless the former can be practiced without materially affecting the area of radiating-surf

The arrangement herein described is conducive, also, to economy, in that owing to the greater mass or density per unit of incandescing-surface of the carbons their life is lengthened.

What I claim is—

1. The combination, with one multiple-arc or derived circuit, of two or more incandescent electric lamps arranged in series therein, the density and electrical conductivity of the carbons of the lamps being increased proportionately, substantially as set forth.

2. The method of arranging a series of incandescent lamps in a multiple-arc or derived circuit, consisting in increasing the density and electrical conductivity of the individual carbons approximately in the proportions to the number to be placed in the one circuit, substantially as set forth.

3. The combination, with one derived circuit, of two or more lamps each of a fractional resistance of the resistance of a standard lamp, but with approximately the same radiating-surface, substantially as set forth.

4. In a system of electric lighting, the combination, with the main circuit, of several multiple-arc or derived circuits, some containing a standard lamp and some containing a series of lamps, two, three, or more, the electrical conductivity and density of the carbons in any one derived circuit in the latter instance increasing as the number of lamps used in such circuit increases, substantially as set forth.

5. The combination, with one derived circuit and one circuit-controller, of two or more lamps each of a fractional resistance of the resistance of a standard lamp, but with approximately the same radiating-surface, substantially as set forth.

This specification signed and witnessed this 19th day of January, 1881.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,
WM. CARMAN.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MANUFACTURING CARBONS FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 242,900, dated June 14, 1881.

Application filed November 5, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Art of Manufacturing Carbons for Electric Lamps, (Case No. 256;) and I do hereby declare that the following is a full and exact description of the same.

The object of this invention is to furnish a method or process by which pure and flexible carbon may be manufactured in any desired shape, which method is particularly applicable to the manufacture of carbon conductors for incandescent electric lamps.

Thin sheet metal which will stand high temperatures—for instance, sheet nickel or cobalt—is cut or formed into the proper shape desired for the finished carbon. One or several such formed pieces of metal are suspended in a closed flask, which is then heated to a high temperature. While in this heated condition the vapor of a hydrocarbon is passed through the flask, with the result that the carbon is deposited upon the metal shapes. For this purpose the vapor of the bisulphide of carbon, the chloride of carbon, the volatile paraffine, or naphtha is preferable. The vapor is passed through the flask until a sufficient thickness of carbon has been deposited upon the forms, when the flask is allowed to cool. When cool the carbon-coated metal plates are immersed in some acid having an affinity for the metal used, and the metal thereby eaten away, leaving the pure carbon in the desired shape.

This process is especially applicable to the manufacture of carbons for incandescent electric lamps, in which case, if desired, the metal used may be in the shape of wire or ribbon bent into the proper form, or may be cut from a sheet, as before described.

What I claim is—

The improved method herein described of forming carbon in definite shape, consisting in depositing the carbon upon a metallic blank, and then removing the metallic portion by immersing the whole in a bath of acid capable of dissolving the metal, substantially as described.

This specification signed and witnessed this 21st day of October, 1880.

THOS. A. EDISON.

Witnesses:

CHAS. BATCHELOR,
WM. CARMAN.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.
Electric Meter.

No. 242,901. Patented June 14, 1881.

Fig. 1.

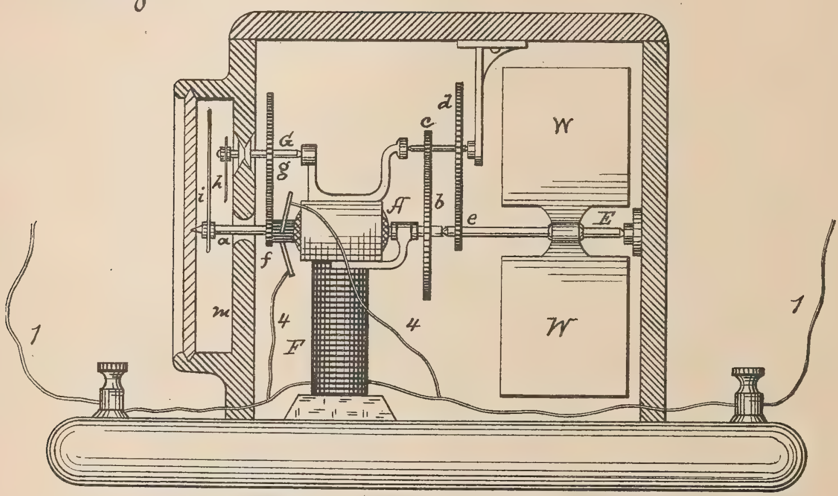
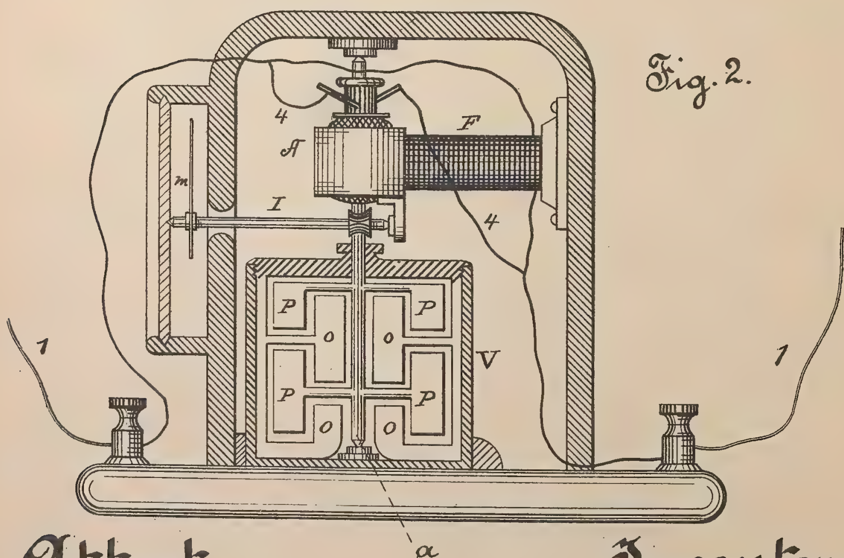


Fig. 2.



Attest
S. D. Mott
M. J. Clagett.

per

Inventor:
T. A. Edison
Dyer & Wilber
Attys

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

Electric Meter.

No. 242,901. Patented June 14, 1881.

Fig. 3.

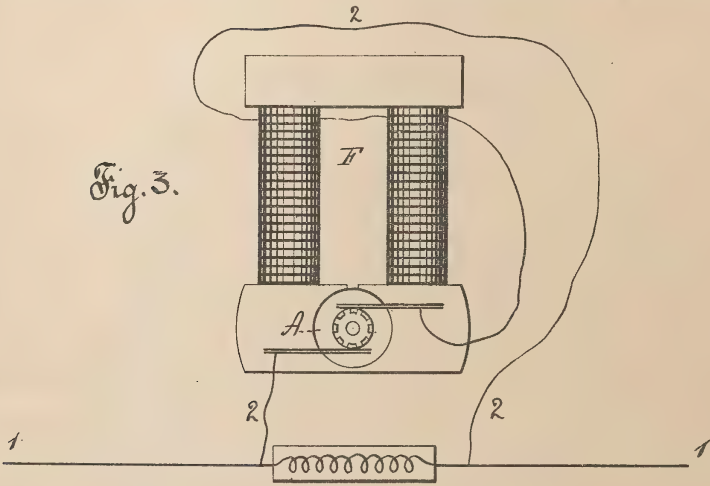
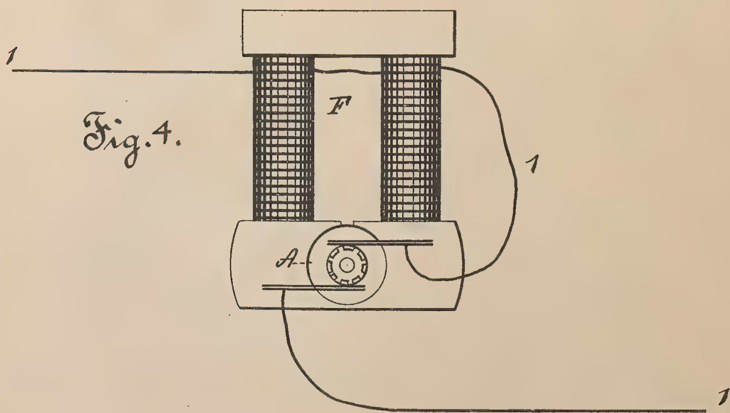


Fig. 4.



Attest:

S. D. Mott

M. J. Clagett.

Inventor:

T. A. Edison

per Dyer & Wilber

Attys

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 242,901, dated June 14, 1881.

Application filed March 3, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Meters, (Case No. 291;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In a system of electric generation and distribution, wherein electricity is generated at a central station and thence distributed to consumers, a meter which shall indicate exactly the amount supplied to a customer is a desideratum.

The invention in this case relates to such a meter.

Generally speaking, it consists of a motor, to which is given a certain definite amount of work to do or resistance to motion to be overcome, combined with registering devices which register the amount of work done or resistance to motion overcome.

I have found that the rapidity with which the motor will accomplish its work with a definite loading is proportioned to the amount of current energizing it. Hence, if the motor be arranged to have a slow motion when the amount of current necessary for, say, one translating device, passes through the circuit its speed will be increased proportionately as the number of translating devices using current is increased.

The motor may be placed with its field and armature coils both directly in the main circuit or both in a shunt-circuit. The field-coils may be placed in the direct circuit and the armature in a shunt thereto.

The loading or resistance may be given in a variety of ways. For instance, fan-blades or wings may be connected to the armature-shaft by multiplying gearing; or, preferably, blades or wings may be driven in a tank or dash-pot filled with a thick liquid, such, for instance, as are used in gas-meters, the armature-shaft being connected to suitable registering devices, such, for instance, as are used in gas-meters, by slowing-down gearing or worm and screw, so that the movement of the registering devices is much less than that of the actuating rotating armature. In the drawings means for accomplishing this are shown, wherein—

Figures 1 and 2 are views showing the motor and fans in elevation, and Figs. 3 and 4 are diagrams giving different methods of connecting the motor in circuit.

In these drawings, 1 1 is one of the main conductors of the place of consumption, the other not being shown.

F is the field-of-force magnets, and A the revolving armature of an electro-motor. In Figs. 1 and 2 the coils of F are directly in the circuit 1, while the armature is in a shunt-circuit, 4. In Fig. 3 both A and F are in a shunt-circuit, 2, while in Fig. 4 both A and F are directly in the main circuit 1.

In Fig. 1, *a* is the shaft of the armature A, and upon one end it carries a gear, *b*, which meshes into a pinion, *c*, on whose shaft is a gear, *d*, taking into a pinion, *e*, on a shaft, E, carrying the wings or fan-blades W, which give the load or resistance to motion to the engine. The shafts of the gears and pinions and blades are supported in suitable framing, and by the arrangement shown the rate of motion of A is increased in W, whereby large reduction in size of W is effected. Upon the other end of the shaft *a* of A is a pinion, *f*, and an index-finger, *i*, the latter passing over a register-face, *m*, which, in practice, corresponds to the first wheel of the register employed in a gas-meter. The pinion *f* meshes with a gear, *g*, on whose shaft is an index-finger, *h*, the pinion *f* and gear *g* being so proportioned that *h* shall advance one step or registration to a complete revolution of *i*.

In Fig. 2 the shaft *a* of A carries the fan-blades or wings P P, working in contracted spaces formed in the vessel or dash-pot V by projections O, extending inwardly from its sides. This vessel or pot may be filled with a liquid, such as glycerine or petroleum, so that the definite work or load for the motor may be given it in a very small space or compass. Upon *a* is a screw meshing into a worm upon shaft I, carrying index-pointer *m*, to which may be added carrying devices, as in case of Fig. 1. As the load is constant, the rapidity with which work is done will depend upon the energizing of the motor, which, in turn, is dependent upon the current flowing through 1 1,

which is determined by the number of translating devices in use upon the circuit to be measured. Hence, as more or less current is used the registration at the time proceeds faster or slower, with the result that a substantially correct indication of the current used in any given time is obtained.

What I claim is—

1. The combination, with an electric circuit containing translating devices, of an electric motor having a definite loading and apparatus for registering the work done, substantially as set forth.

2. The combination of an electric circuit, an electro-motor, a fan driven thereby, and a registering apparatus, substantially as set forth.

3. The combination of an electric circuit, an electro-motor, a fan or blades driven thereby, a vessel or tank in which the fan or blades are placed, and registering apparatus, substantially as set forth.

4. The combination of an electric circuit, an electro-motor, a fan or blades, a vessel or tank filled with liquid, in which the blades or fan are placed, and registering apparatus, substantially as set forth.

5. An electric meter consisting of a motor having a definite work to perform or loading to overcome, and registering devices, substantially as set forth.

This specification signed and witnessed this 24th day of February, 1881.

THOS. A. EDISON.

Witnesses:

S. D. MOTT,

H. W. SEELY.

(No Model.)

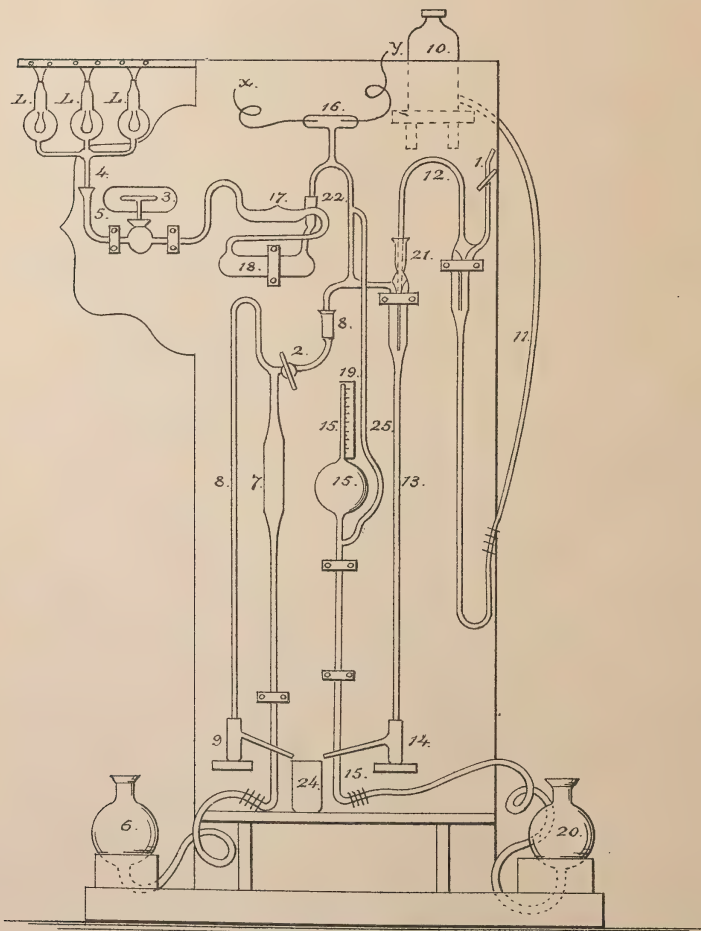
3 Sheets—Sheet 1.

T. A. EDISON.

APPARATUS FOR PRODUCING HIGH VACUUMS.

No. 248,425. Patented Oct. 18, 1881.

Fig. 1.



Attest:
F. W. Howard
F. H. Hall

Inventor:
T. A. Edison per
Dyer & Mill
Attys.

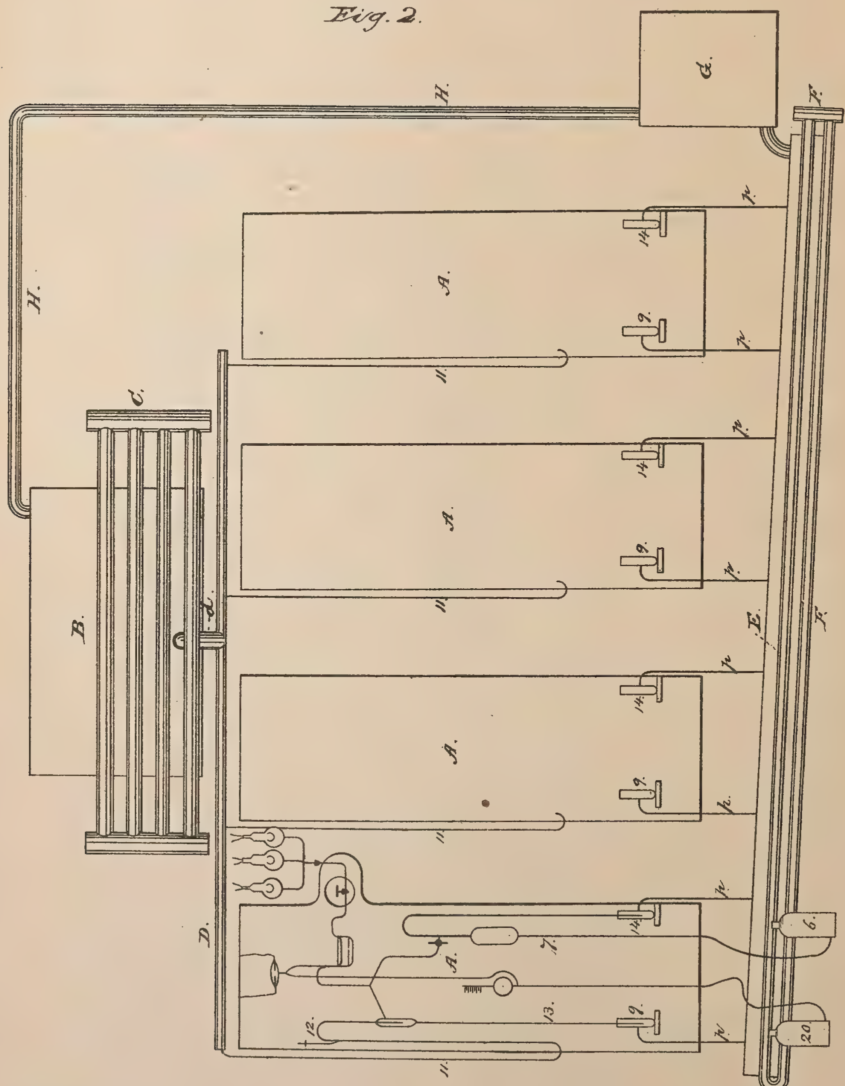
(No Model.) 3 Sheets—Sheet 2.

T. A. EDISON.

APPARATUS FOR PRODUCING HIGH VACUUMS.

No. 248,425. Patented Oct. 18, 1881.

Fig. 2.



Attest:

Sam. D. Mott

Frank H. Hall

Inventor:

T. A. Edison per

Dyer & Wilber

his Attys

N. PETERS, Photo-Lithographer. Washington, D. C.

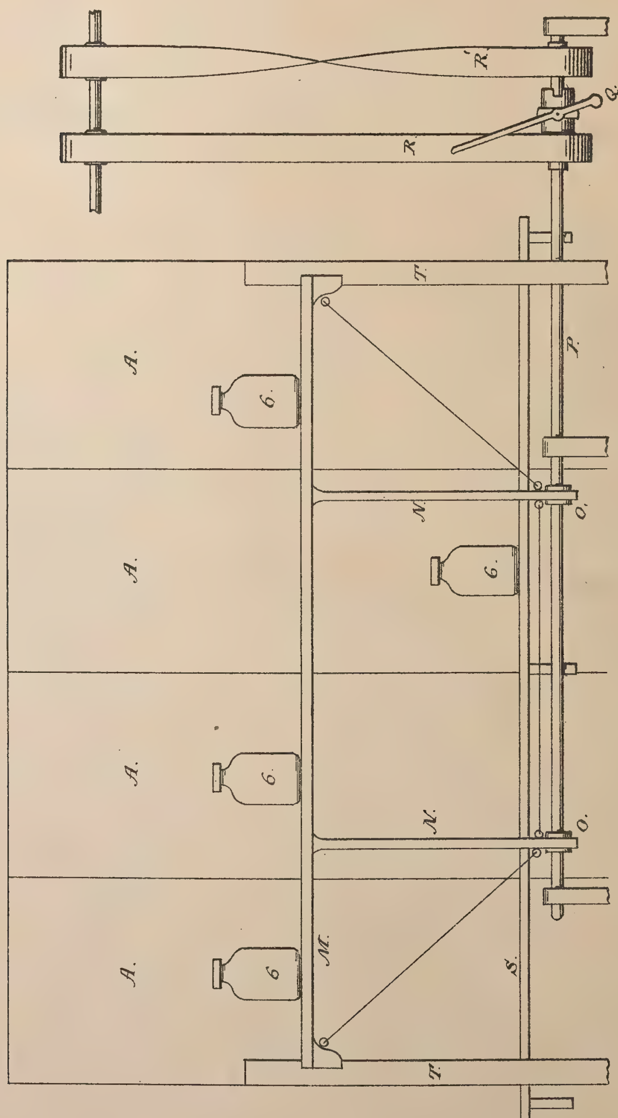
(No Model.) 3 Sheets—Sheet 3.

T. A. EDISON.

APPARATUS FOR PRODUCING HIGH VACUUMS.

No. 248,425. Patented Oct. 18, 1881.

Fig. 3.



Attest:

F. W. Howard

G. H. Meall

Inventor:

T. A. Edison per

Dyer & Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

APPARATUS FOR PRODUCING HIGH VACUUMS.

SPECIFICATION forming part of Letters Patent No. 248,425, dated October 18, 1881.

Application filed March 29, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Menlo Park, in the State of New Jersey, have made certain new and useful Improvements in Apparatus for Producing High Vacuums, of which the following is a specification.

Heretofore high vacua have been only produced in the laboratory by the expenditure of much time and care and by men celebrated for their skill in that department—such as Sprengel, Geissler, Warren, De La Rué, and Wm. Crookes. Bulbs exhausted by the means these savants employ are very expensive, as the operation was tedious and the precautions many, so that any device where a part is a highly-exhausted receiver could not, except in rare cases, be made a commercial success, on account of the tediousness and expense of producing the high vacuum, which increases as the exhaustion is carried higher.

In my electric lamps containing an incandescent conductor of carbon it is essential that very high exhaustions should be attained to insure the permanency of the conductor, by reducing the amount of nitrogen and oxygen in the bulb to an amount inappreciable, as compared with the mass of the conductor, which itself is ordinarily but the one-eighth of a grain. Being necessary to produce these lamps in vast quantities and very cheaply, in order to insure their adoption, the cost of production should be brought down to a minimum. To aid in this the time required for exhausting the bulbs should be reduced many times less than in the laboratory experiments heretofore noted, and such arrangements or combinations should be devised and used as will allow of one person attending to many exhausters.

The object of my invention is to accomplish this; and to that end there is combined with a series of pumps adapted to exhaust the air from closed receivers by the flow of mercury, of a general or common reservoir of mercury, a general or common mercury-well, and a pump worked by any suitable motor for continuously returning the mercury from the well to the reservoir. From the reservoir leads a pipe with branches to each exhaust-pump, and to the well leads a pipe into which all the exhaust-pumps discharge. The reservoir, the well, and the tubes or pipes therefrom and thereto are surrounded by heating-pipes—air or steam—or they are otherwise heated, in order that the mercury may be kept warm and free from moisture, for the reason that mercury used warm acts to produce a high vacuum in very much less time than when used cold. The individual exhaust-pumps are formed of the Geissler pump and the Sprengel drop-pump, with a MacLeod gage for determining the degree of exhaustion. With each individual pump is combined receptacles for containing material for absorbing moisture and mercurial fumes, and a Geissler tube for indicating readily when a certain degree of exhaustion has been reached. In using the Geissler pump and the MacLeod gage it is necessary to lift mercury-reservoirs, the general reservoir and pump for the Sprengel drop not being adapted therefor. To accomplish this readily two shelves are arranged, one stationary, one moving in ways and provided with mechanism for raising and lowering it. An attendant, seeing that it is requisite to raise the reservoirs of the Geissler pumps or of the gages of a number of pumps, simply slides the reservoirs therefor from the stationary to the moving shelf, and the entire number is raised and then lowered at once.

For a more particular description reference is to be had to the drawings accompanying and forming part of this specification, in which—

Figure 1 is a plan of an individual pump, and Fig. 2 a plan of a series. Fig. 3 is a view of the apparatus for raising and lowering the reservoirs connected with the Geissler pump and MacLeod gages.

In Fig. 1, the left-hand portion (6, 7, 8, are connections to the lamps L L L) is a Geissler pump, while the right-hand portion (11, 12, 13, &c.) is a Sprengel drop-pump. The lamps L L L, more or less in number, are attached to a tube, 4, which is secured to the pumps at the mercury-seal 5. The terminals 9 14 of the pumps are sealed by mercury. All joints and stop-cocks (for example 1, 2, 3, 21, 22, &c.) are provided with mercury-seals. 6, 10, and 20 are suitable mercury-reservoirs. The Geissler pump is first used. Stop-cocks 1 2 are opened and receptacle 6 is raised sufficiently high to fill 7 and 8. This forces the air in 7 out through 1, which is then closed, the receptacle 6 lowered,

and cock 3 opened. The mercury in 7 flows back into 6, creating a partial vacuum or attenuation of air in the lamp-bulbs L. The degree of attenuation obtained is due to the relative capacity of the enlargement of 7 and the remainder of the apparatus then in use, a quantity of air, or attenuated air, equal to that contained in 7 being withdrawn at each operation.

The operations described are repeated until a considerable degree of exhaustion in L L is obtained. The cocks 1 and 2 are then closed and the Sprengel pump alone used. The receptacle 10 is filled with mercury, which flows through 11 and 12 and drops into tube 13, the end of 12 being reduced in size so that drops only shall flow therefrom. Each drop falling from 12 into 13 acts as a piston, carrying before it a small quantity of attenuated air, which is forced out through 14, the overflow of mercury going into 24.

At 16 is combined with the pumps a Geissler tube, which is included in the circuit of an induction-coil, (represented by the conductors *x y*.) Upon the reaching of a high degree of vacuum the current ceases to pass therethrough, giving a visual test, which saves much time and labor, as so long as the current passes therethrough it is unnecessary to use the MacLeod gage 15, 19, 20.

In the line of pipes between the lamps and the pumps are the receptacles 17 18, in which are placed materials adapted to absorb moisture and mercurial fumes or vapors, so that neither moisture nor mercurial vapor may be present in the lamps, to their detriment after they shall have been exhausted of air.

For testing the degree of attenuation after the current ceases to pass through 16 recourse is had to a MacLeod gage, 15, which consists of a tube having a large bulb and ending in a capillary tube provided with a scale indicator, 19. The tube 15 is in communication with the system of pumps through 25, and is connected also by a flexible tube with a mercury-reservoir, 20. If 20 be raised to the height, say, of 19, the mercury flows through 15, in which, of course, is exactly the same degree of atmospheric tension as in the remainder of the system until the union of 15 and 25 is sealed, the mercury then acting to compress whatever of atmosphere there is in the bulbs of 15 into the tube. The scale indicator shows the degree of attenuation. When the proper degree of vacuum is thought to be reached an electric circuit is closed through the lamps and the conductor therein rendered incandescent. This aids to definitely determine if the proper degree has been reached. When ready the neck of each lamp is softened by heat and the parts sealed together, the current being kept on and the pumps operating in order that it may be seen if the proper vacuum is maintained during the process.

In practice I connect a very large number of pumps in one series, as shown diagramatically in Fig. 2, in which four pumps, A A A A, are shown, to which number, however, I am not limited, as the series may be extended to, say, one hundred pumps, each complete in itself.

A reservoir, B, of mercury is provided, from which leads by means of a tube, *d*, a general delivery-pipe, D, to which is connected the pipe 11 of each pump of the series.

The receptacles 9 14 of each pump are connected by small pipes *p p* to an inclined well, E, in which the mercury collects after passing from B through the pumps.

At G is located any suitable pump and motor, steam or magnetic, by which the mercury is continuously pumped back into B through the pipe H from the well E. The reservoir B and well E are surrounded by hot-air or steam pipes, or they are otherwise heated, so that the mercury may be kept quite warm. By thus heating the mercury any watery vapor therein contained is driven off, the mercury flows more readily and quickly, the pumps operate thereon more easily, so that a larger volume flows in a given time, the ultimate results being that no injurious vapor is left in the lamps, and the time necessary for the exhaustion of a lamp is shortened, with a consequent increase of amount of work accomplished by a pump. Each pipe 7 may also be connected to D, a suitable stop-cock being placed in 7.

In Fig. 3, M is a movable shelf sliding on ways, T T, and provided with racks N N, in which gear pinions or cogged wheels O O on shaft P, which receives motion through the medium of belts R R′. One of these belts, R′, is crossed, so that when in operation it shall give a motion the reverse of that given by R. These belts run over loose pulleys on P, a clutch or reversing gear, Q, being used to connect, as desired, one or the other to P.

S is a fixed shelf, and 6 6 represent reservoirs.

A A are a series of pumps.

It is evident that the reservoirs of a number of pumps can be moved from S to M and raised at one movement, simultaneously filling with mercury the Geissler pumps or MacLeod gages.

What I claim is—

1. The combination, with a vacuum-pump, of a Geissler tube, substantially as set forth.

2. The combination of a series of vacuum-pumps, a common mercury-reservoir, a common mercury-well, and a pump for returning the mercury to the reservoir from the well, substantially as set forth.

3. The combination, with a series of vacuum-pumps, of means for mechanically raising and lowering at will one or more of a series of mercury-reservoirs, substantially as set forth.

4. The combination, with a series of mercury-reservoirs, of a fixed shelf, a moving shelf, and actuating mechanism therefor capable of reciprocating movement, substantially as set forth.

5. The combination, with a series of vacuum-

pumps, a mercury-reservoir, and a mercury-well, of means for heating the mercury, substantially as set forth.

6. In treating mercury for use in drop or Sprengel pumps, the method of relieving the mercury of watery vapors and causing it to flow more readily, which consists in heating the mercury prior to its passage through the pumps, substantially as set forth.

In testimony whereof I have hereunto affixed my signature this 28th day of January, 1880.

THOS. A. EDISON.

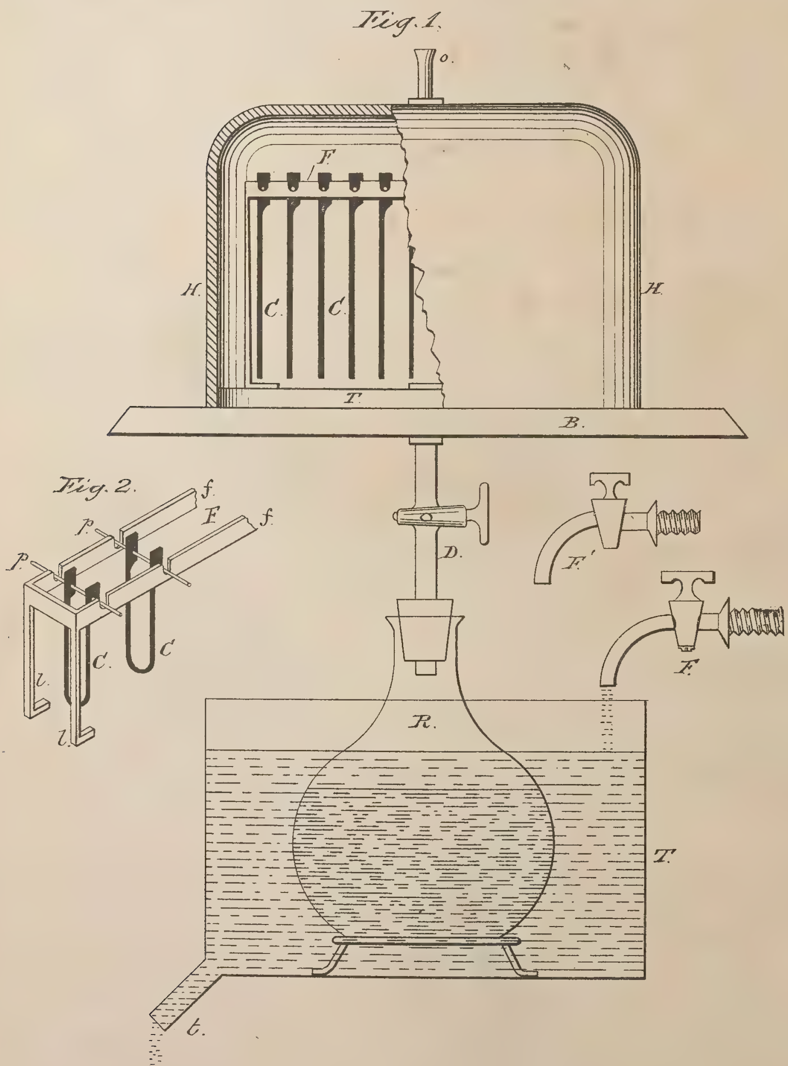
Witnesses:
SAM. D. MOTT,
C. P. MOTT.

(No Model.)

T. A. EDISON.

APPARATUS FOR TREATING CARBONS FOR ELECTRIC LAMPS.

No. 248,426. Patented Oct. 18, 1881.



Attest:

D. D. Mott

J. F. Randolph.

Inventor:

Thos. A. Edison

per Dyer & Wilber

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

APPARATUS FOR TREATING CARBONS FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 248,426, dated October 18, 1881.

Application filed November 24, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Method of Treating Carbons for Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

It has been heretofore fully explained by me that exceedingly-desirable carbons for the incandescent conductors of electric lamps may be made of fibrous vegetable materials, especially those like the bamboo and other members of the family of "Gigantic grasses," in which the body is composed of a large number of exceedingly fine fibers lying parallel to each other, and having a minimum of foreign or extraneous matters. In treating such fibrous substances to effect their conversion into carbons it often happens that one or more of the fibrillae, composing what is known as the "fiber," becomes ruptured, destroyed, or injured. This rupture is usually invisible to the eye; but when the finished carbon is put to use an arc is apt to form thereat, which, increasing, finally destroys the carbon.

The object of the present invention is to furnish a method of and means for treatment of the carbons so as to greatly reduce or practically eliminate such danger. The carbons used are preferably constructed with enlarged ends for clamping, small holes being formed in the enlarged ends for the reception of the clamping-screws. The fibers so constructed and carbonized are taken and hung in a suitable frame by means of pins passing through the screw-holes referred to. The frame is placed in a flask capable of sustaining a high degree of heat, for which purpose nickel is the best adapted, and a stream of vapor from a carbon compound passed therethrough, while the flask and its contents are subjected to an intense heat. The carbon vapor is one which will be decomposed by high heat, the result being that there is a deposition of carbon upon the carbonized fibers, filling any breaks and uniting the disjoined ends of any of the ultimate or unitary fibers which have been ruptured or injured.

For practicing the invention an apparatus like that shown in the drawings may be used, in which Figure 1 represents the apparatus, partly in plan and partly in section, while Fig. 2 is a view of the frame or rack detached from Fig. 1.

C C C are carbons, made with enlarged ends, in which are screw-holes, through which are passed the pins *p p*, by which the carbons are suspended in a rack or frame, F, made of suitable side pieces, *f f*, supported on legs *l l*.

On any suitable base, B, is placed the piece I, which forms the bottom of a flask, whose other portion is the cover or case H, within which is placed the frame F, loaded with carbons, as seen in Fig. 1.

In a water-tank, T, is a reservoir, R, filled with a carbon compound capable of vaporization. From R a pipe, D, provided with a stop-cock, leads to the interior of the flask H. The tank T may be heated in any suitable manner. A faucet, F, admits hot water therein, which causes the vaporization of the liquid in R, while F′ may be used to admit cold water for lessening or entirely checking the production of vapor. Vapor is caused to pass through D into H, the surplus burning at *o*. At the same time the flask and its contents are heated in any suitable furnace, the heat causing a decomposition of the carbon vapor and a consequent deposition of carbon upon the carbonized fibers. By this arrangement the vapor has free access to all parts of the carbonized fibers, so that the carbon may be deposited upon the entire surface.

What I claim is—

The combination of a flask adapted to be heated in any suitable manner, a frame therein for supporting separately and freely from each other carbon filaments, and means for passing through the flask a stream of hydrocarbon vapor, substantially as set forth.

This specification signed and witnessed this 5th day of November, 1880.

THOS. A. EDISON.

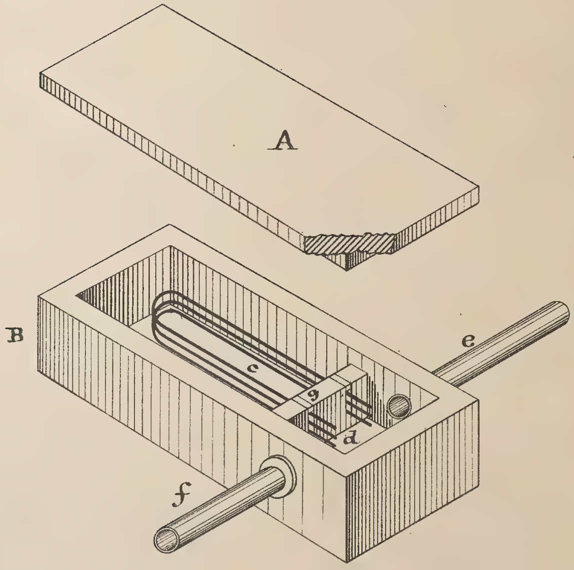
Witnesses:
JOHN F. RANDOLPH,
WM. CARMAN.

(No Model.)

T. A. EDISON.

APPARATUS FOR TREATING CARBONS FOR ELECTRIC LAMPS.

No. 248,427. Patented Oct. 18, 1881.



Attest:

S. D. Mott

F. H. Hall

Inventor:

Thos. A. Edison

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

APPARATUS FOR TREATING CARBONS FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 248,427, dated October 18, 1881.

Application filed January 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Carbons for Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

A now ordinary form of electric lamp, as shown in several patents hitherto granted me, consists of a carbon filament secured to conductors and hermetically inclosed in an exhausted glass globe or containing-chamber. In order that reliable and perfect electrical contact between the ends of the carbon filament and the conductors leading and secured thereto may be had, it is necessary that the ends of the filament be enlarged somewhat, so as to furnish a larger bearing and contact surface. When the nature of the material used admitted of it these enlarged clamping ends have been formed integral with the filament. In some cases, however, fibers are used for the carbon filament of such size that they have not the mass of material necessary for the clamping ends to be formed integral therewith, when such ends must be formed or made thereon out of other carbon.

My invention consists in a method and apparatus for this purpose, the latter being shown in the accompanying drawing.

B is an iron flask or vessel, having a cover, A, which fits tightly thereon. The flask is divided by the partition *g* into two compartments, *c* and *d*. A number of carbon loops are placed in the flask, as shown, the larger part of each being in the compartment *c*, while the ends pass through slits in the partition *g* and project into the compartment *d*. The cover is then placed on the flask, and the part of the flask comprising the compartment *d* is heated to a high temperature in any suitable manner, which may be, for instance, by placing the whole flask in a furnace, the compartment *c* of the flask being filled with finely-powdered charcoal or carbon, which protects the portions of the carbons therein sufficiently to prevent their destruction or injury, at the same time preventing such diffusion of gas from the compartment *d* as would make any sensible deposit on the portions in *c*. Then, while the carbons are still very hot, the carbon vapor is forced into the pipe *f*, and passes across the compartment *d* and out of the pipe *e*. During its passage across the ends of the heated carbons it will be decomposed, and will deposit other carbon thereon, which will become a part thereof, thus enlarging the ends without increasing the size of the rest of the loop.

What I claim as my invention is—

1. The method of forming enlarged or clamping ends upon carbon filaments and increasing the conductivity thereof, consisting in confining the ends of the filaments in a closed flask or vessel, heating such ends of the filaments to a high heat while carbon vapor is passed through the chamber, the part of the filaments not to be enlarged being suitably supported and protected, substantially as set forth.

2. A flask or vessel divided by a partition into two parts, one of which is provided with inlet and outlet pipes for the passage of hydrocarbon vapor, substantially as and for the purpose described.

This specification signed and witnessed this 21st day of December, 1880.

THOS. A. EDISON.

Witnesses:

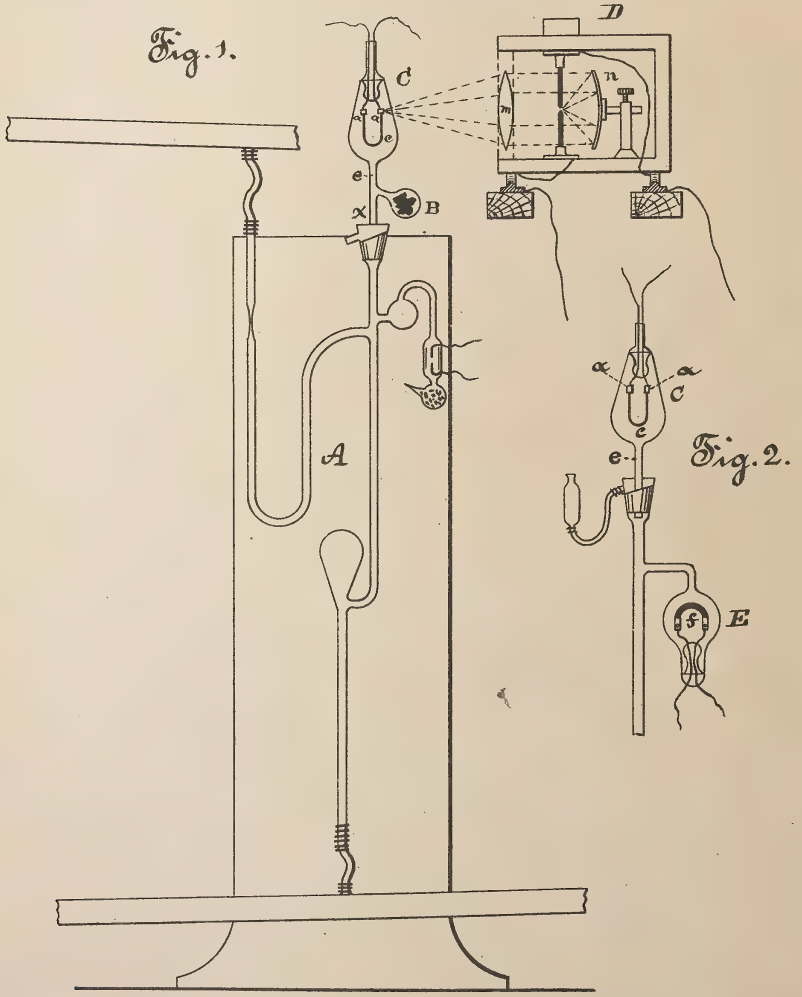
H. W. SEELY,
ERNEST J. BERGGREN.

(No Model.)

T. A. EDISON.

MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS.

No. 248,428. Patented Oct. 18, 1881.



Attest:

S. D. Mott

M. J. Clagett

Inventor:

Thos. A. Edison.

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 248,428, dated October 18, 1881.

Application filed January 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescent Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to that class of electric lamps in which the light is caused by the incandescence of a filament of carbon inclosed in a glass globe. In these lamps it is necessary that the interior of the inclosing-globe should approach as nearly as possible to being a perfect vacuum. A nearly-complete vacuum may be formed in the globe by the use of mercury-pumps; but in the carbon filament and the platinum clamps which hold it there is always a certain amount of occluded air and other gases, which, if they were not removed, would escape, on the carbon becoming heated, into the globe, and thus lower the vacuum therein. These occluded gases may be removed from the carbon itself by simply heating it to incandescence before sealing off the glass; but that portion of the carbon which is held within the clamps, and the clamps themselves, are heated to a less degree than the remainder of the carbon, and consequently the gases are not driven off. It is necessary, therefore, to provide some means whereby these gases may be removed before sealing the globe. To do this I concentrate on the clamps the heat from some external source—as, for instance, from the sun or from a voltaic arc-lamp—which has the effect to drive off the occluded gases therefrom, and these gases are then absorbed by a quantity of heated charcoal, the globe afterward being sealed off. Arrangements for this purpose are shown in the accompanying drawings, in which—

Figure 1 is a view of my apparatus for this purpose, and Fig. 2 a view of a modification thereof.

C is the inclosing-globe of the electric lamp, *c* being the carbon, and *a a* the platinum clamps, in which the enlarged ends of the carbon are held. The lamp is attached at *x* to the mercury-pump A.

B is a glass bulb, containing a quantity of charcoal, preferably a dense cocoanut-charcoal. This bulb is so arranged that it may be heated by means of a lamp.

A is the mercury-pump, by means of which air is exhausted from the lamp. After as near an approach to a vacuum as possible has been attained, the carbon is heated to incandescence by means of a current of electricity, and the occluded gases therein are thus driven off. There still, however, remains, as stated, a quantity of gas in the clamps and the enlarged ends of the carbon which are never heated to incandescence by the passage of the current.

D is an electric-arc lamp, having a reflector, *n*, placed behind the light, and a lens, *m*, before it, so that the full force of the rays will be concentrated on the clamps *a a*, and they will be heated to a high degree, driving out the occluded gases, which, as they are driven out, are removed by the mercury-pump; but a small amount of gas will still remain in the globe, and to remove it another operation is necessary. The bulb B is heated to a very high temperature, after which the lamp and bulb are sealed off from the pump at *x*. They are then laid aside for twenty-four hours, during which time the carbon filament *c* is occasionally heated, after which the charcoal in the bulb will be found to have absorbed the residual gases from the globe while cooling off. The lamp and bulb may then be separated at *e* by sealing off.

The bulb B may be used for another lamp, the absorbed gas therein being driven off by the application of heat to the bulb.

In Fig. 2 an arrangement is shown which takes the place of the bulb B, and which may be a permanent fixture of the pump A.

E is a glass bulb, and *f* an arc composed of a large piece of cocoanut-charcoal, which is the absorbing material in this case. This does not require a lamp to heat it, as an electric current may be used instead.

Of course the chamber E need not necessarily be permanently attached to the pump, but may be sealed off and again attached, as in the case of the bulb B.

What I claim is—

1. The within-described method of removing the occluded gases or vapors from the incan-

descent conductor of an electric lamp, consisting in heating the same in as near a vacuum as is attainable in the presence of material which will absorb the gases or vapors thereby eliminated, substantially as set forth.

2. The within-described method of removing occluded gases or vapors from the enlarged ends and clamps of the incandescent conductor of an electric lamp, consisting in heating such parts by external heat, focused or centered thereon, in the presence of a material which will absorb the gases or vapors thereby eliminated, substantially as set forth.

3. The combination of an incandescing electric lamp, means for producing a vacuum within its inclosing-globe, and means for concentrating external heat upon the incandescent conductor, and means for absorbing any gases or vapors given off by the incandescent conductor, substantially as set forth.

This specification signed and witnessed this 16th day of December, 1880.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

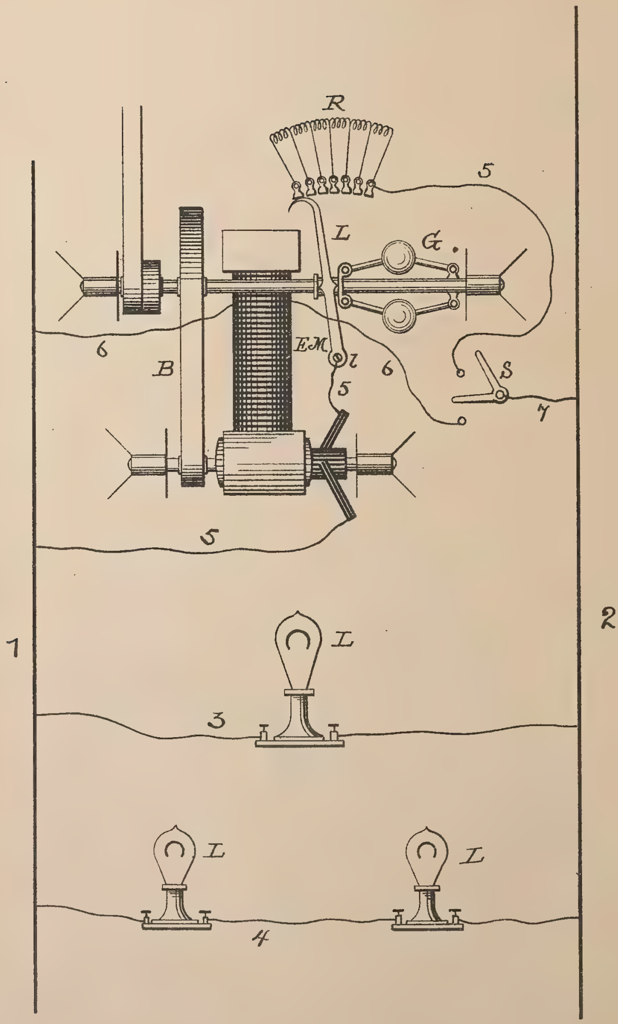
ERNEST J. BERGGREN.

(No Model.)

T. A. EDISON.

ELECTRIC MOTOR.

No. 248,429. Patented Oct. 18, 1881.



Attest:

O. D. Mott

M. J. Slagett

Inventor:

T. A. Edison.

per

Dyer & Wilber

Attys

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 248,429, dated October 18, 1881.

Application filed March 3, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electro Motors; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In systems which contemplate the distribution and utilization of electricity for various purposes—for instance, for both light and power—it is essential that there be such arrangement that the throwing into or cutting out of circuit of translating devices shall not affect those already in circuit or remaining in circuit. I prefer to attain this result by controlling the generators at the central or supply station, so that just the current needed is constantly supplied. When, however, upon one system there are arranged both lamps and motors, some of the latter requiring many times as much current as a lamp, there is apt, as such motors are placed in circuit, to be a momentary effect upon the lamps, visible in the shape of a jump or flicker or drop, before the motor has reached its proper speed. This is also due to the fact that the motors are of much less resistance than the lamp used. When, however, a motor attains its maximum speed, it gives a counter electro-motive force in its own derived circuit, which has the functions of a wire resistance, and weakens the opposing current in its circuit in the same way as would a wire resistance, and compensates for the lessening of actual wire resistance.

It is known that a motor cannot attain its maximum speed immediately; that an interval of time, often very small, but still an appreciable quantity, elapses before the necessary degree of magnetization is reached, inertia overcome, and the maximum speed attained.

The object of this invention is to prevent any effect upon the lamps; and to that end it consists, in general terms, in combining with a motor devices which, when the motor is placed in circuit, prevent the motor from starting up immediately at full head, causing it to gradually attain its maximum power or speed, and to give the counter electro-motive force which takes the place of wire resistance. This may be accomplished by placing in the armature-circuit a resistance and a pivoted lever, normally closing the circuit to the armature through the entire resistance. This lever is controlled by a governor driven from the engine in such manner that as the speed of the engine increases the governor carries the lever from contact to contact of the resistance, gradually cutting it out. This increase of speed causes an increased counter electro-motive force in the motor-circuit, which increase is always sufficient to compensate for the actual wire resistance cut out of circuit by the same cause. Such an arrangement is shown in the drawings, in which—

1 2 represent the main conductors, on derived circuits to which, 3 4, are placed lamps L L, there being any desired number of circuits and lamps.

E M is an electro-motor, arranged to work in the same system, its armature being a derived circuit, 5, and its field-coils in a derived circuit, 6, both circuits being controlled by a double switch, S, attached to a wire, 7. In the circuit 5 of the armature is a resistance, R, and a lever, L, pivoted at *l*.

G is a centrifugal governor, driven by a belt, B, from the shaft of the armature. The lever L is controlled by the governor, so that when the governor is at rest the lever shall make contact with the resistance in such manner as to include all the resistance in the circuit. Upon closure of circuit through the motor it starts slowly; but as speed is increased the rotation of the governor causes the balls to fly out. The lever L is carried so as to cut out part of the resistance, a correspondingly-increased amount of counter electro-motive force being caused by the quickening of speed, until the motor attains its maximum speed, giving an amount of counter electro-motive force which compensates for the resistance cut out.

I have found that by this method of substituting counter electro-motive force for actual resistance the conditions of the motor-circuit may always be preserved practically unchanged, so far as affecting the lights is concerned, actual resistance and counter electro-

motive force being exchanged for each other in rest and motion, and proportionately as the rate of motion. By such an arrangement all sudden effect upon other translating devices is avoided, while the delay in bringing the motor to its maximum is very little, though sufficient to enable the proper compensation to be made.

What I claim is—

The combination, with an electro-motor, of a resistance included in its circuit normally or in a state of rest, and means operated by the motor, and arranged to gradually cut out the resistance as the motor speeds up, and to entirely cut it out when the motor reaches a desired predetermined speed, substantially as set forth.

This specification signed and witnessed this 24th day of February, 1881.

THOS. A. EDISON.

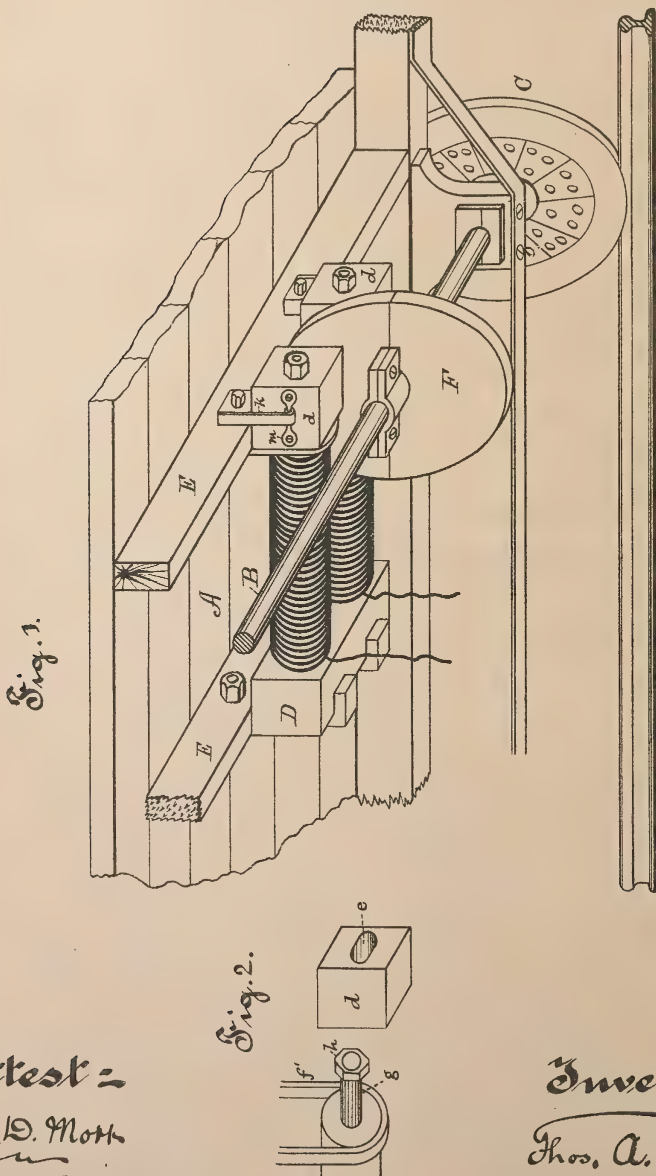
Witnesses:
H. W. SEELY,
S. D. MOTT.

(No Model.)

T. A. EDISON.

ELECTRO MAGNETIC BRAKE.

No. 248,430. Patented Oct. 18, 1881.



Attest:

S. D. Mott

James A. Payne

Inventor:

Thos. A. Edison

per Dyer and Wilber

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRO-MAGNETIC BRAKE.

SPECIFICATION forming part of Letters Patent No. 248,430, dated October 18, 1881.

Application filed July 22, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Electro-Magnetic Brake; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to produce a simple and effective electro-magnetic brake, adapted for use on any style of railroad-vehicle, but more especially intended for use in connection with a system of electro-magnet railways, such as is shown and described in my prior application bearing the Patent Office serial number 11,243.

It consists in placing an electro-magnet in such relation to some rotating metallic portion of the running-gear of the vehicle to be stopped that the magnetic circuit shall be through such rotating metallic portion, the electro-magnet being furnished with mobile heads, which may move toward and clasp the rotating portion whenever the circuit of the magnet is closed. Upon the axle, and at or near its center, is rigidly fixed a disk of iron, which rotates with the axle and between the polar extremities of an electro-magnet suitably fastened to or supported from the bottom of the car. The cores of this electro-magnet are extended beyond the coils, forming a spindle, which is reduced in size when necessary, the ends being screw-threaded to receive nuts. Upon each spindle is placed a block of iron or other magnetic metal, forming a polar extension, secured in place by a nut. The orifices in the blocks, into which the spindles pass, are elongated, so that the blocks or polar extensions may have a movement to or from the fixed disk upon the axle rotating between them. The polar extensions are normally held away from the disk by suitable springs of low resilience. When it is desired to use the brake a circuit from any suitable source of electricity is closed through the coils of the electro-magnets, whereupon the polar extensions mutually attract the disk. It, however, being fixed, while they are movable, the attractive force causes them to move to the disk and grasp it between them, causing a retardation or stoppage in its rotation, and so acting, through it, as an effective brake upon the wheels. Upon breakage of the circuit the springs restore the polar extensions to their normal position. When desired, for the purpose of throwing the brakes off instantly, a momentary reverse current may be thrown into the circuit just after breaking, causing a momentary but instantaneous repulsion from the disk, and assisting the springs in removing the polar extensions. It is evident that instead of one several sets of such brakes may be applied to each axle when desired.

In the drawings, Figure 1 is a perspective view of a portion of the bottom of a car, showing a brake. Fig. 2 shows the polar extension and spindle of the core in detail.

A is the bottom of a car, resting upon the framing E E.

B is an axle, extending from wheel C to wheel on other side. (Not shown.) Upon this axle is rigidly secured the iron disk F, rotating between the polar extensions *d d* of electro-magnet D, suitably secured to the framing E E. Each of the cores of the magnet extends beyond the coils, forming a spindle, *g*, on each core, whose end is screw-threaded to receive a nut, *h*. Each polar extension *d* is formed with an elongated slot, *e*, so that it may be fitted upon the spindle and be free to move thereon in one direction—viz., to and from the disk F. A spring, *k*, which may be any of the well-known forms, is combined with each polar extension and serves normally to hold it away from the disk.

It is evident that the electro-magnet D may be mounted so that the flange or a portion of the web of the wheel C shall rotate between *d d*, and they operate directly thereon instead of upon a disk, the vital principle of the invention being that the magnetic circuit of the electro-magnet shall be closed through some moving portion.

What I claim is—

1. The combination, with an electro-magnet, of polar extensions mounted upon the ends of the limbs of the magnets, and having movement thereon to and from each other, and adapted to grasp between them an armature, substantially as set forth.

2. The combination of a disk, rigidly mounted upon an axle, and an electro-magnet, with movable polar extensions, between which the disk rotates, substantially as shown and described.

3. In an electro-magnetic railway-brake, the combination of a fixed or stationary electro-magnet, movable polar extensions mounted thereon, and a rotating armature, consisting of a portion of the running-gear, or of a metallic disk attached thereto, substantially as set forth.

This specification signed and witnessed this 2d day of July, 1880.

THOS. A. EDISON.

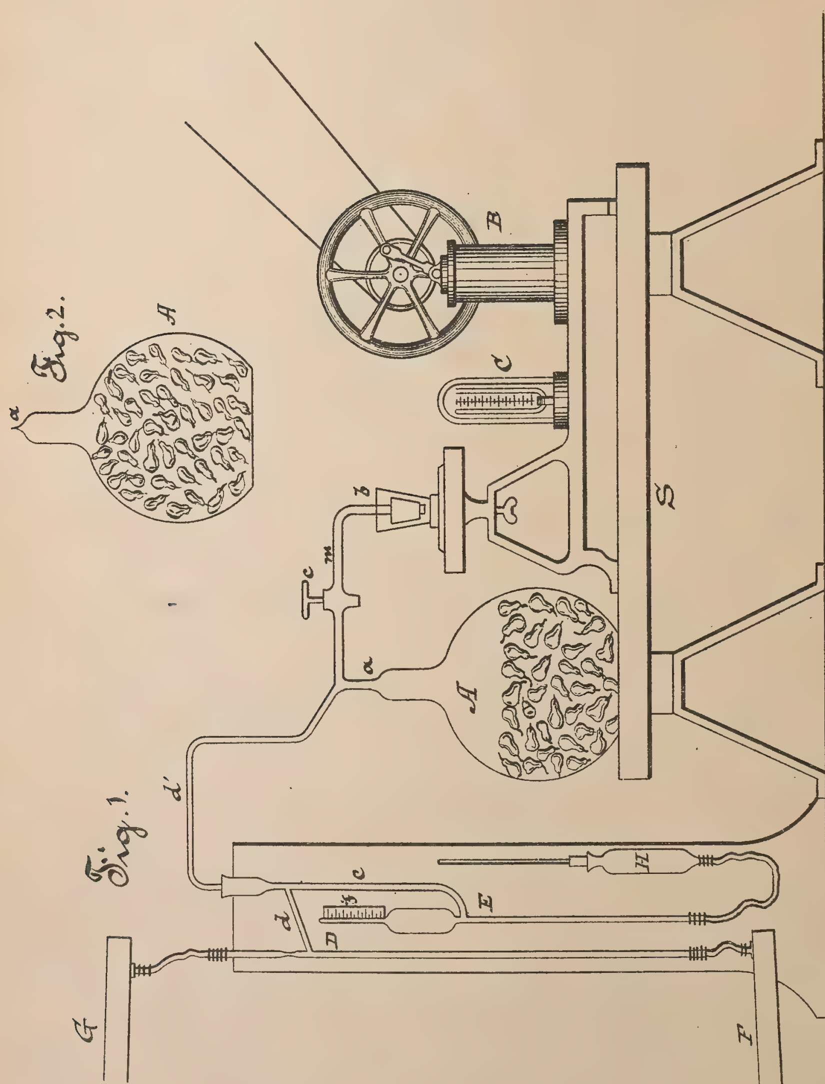
Witnesses:
FRANK McLAUGHLIN,
SAMUEL EDISON.

(No Model.)

T. A. EDISON.

PRESERVING FRUIT..

No. 248,431. Patented Oct. 18, 1881.



Attest:

S. D. Mott

F. W. Howard

Inventor:

Thos. A. Edison

per Dyer & Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

PRESERVING FRUIT.

SPECIFICATION forming part of Letters Patent No. 248,431, dated October 18, 1881.

Application filed December 14, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Preserving Fruit; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce an economical method of putting up fruits, vegetables, and other organic substances in their natural condition without cooking, for preservation in high vacuo, which method will insure the maintenance of such high vacuo, and consequently the preservation of the articles; and the articles will be surrounded by an envelope which cannot affect them injuriously. This I accomplish by placing the articles to be preserved, or one of them, in a properly-constructed glass vessel, which is shaped up and connected with a glass tube leading to or connected with apparatus for producing in the vessel a high degree of exhaustion; or the opening of the vessel through which the articles are placed therein may be closed by fusion, and the glass exhaust-tube attached at any other suitable point. When the desired high vacuum is obtained the glass tube is "sealed off"—that is to say, the tube is fused by the flame of a blow-pipe—at a point near the vessel, and the vessel is drawn away from the tube at the point of fusion, the result being to hermetically close the vessel and at the same time disconnect it from the glass tube. The articles are then inclosed in an envelope which is essentially a homogeneous piece of glass, and which will maintain for any length of time the high vacuum. The envelope being entirely of glass, the articles cannot be affected injuriously thereby.

My invention consists, first, in the peculiar method of putting up organic substances for preservation and transportation; and, second, in the complete vessel as a new article of manufacture, having the articles sealed in high vacuum therein by the fusion of the glass, the articles being surrounded by an envelope composed essentially of one piece of glass.

In the drawings, Figure 1 is an elevation of the apparatus employed by me for producing high vacuo, a vessel being shown as connected therewith; and Fig. 2, a view of the complete vessel.

A is the vessel, made of glass and filled, or partly filled, with the fruit, vegetables, or other organic substances to be preserved; or it may be made of proper size for holding a single article. The glass vessel is shaped up and joined with a glass tube, *a*, connected with the air-exhausting apparatus. This junction may be formed in several ways. The neck of the vessel may be fused to the glass tube, as shown in Fig. 1; or the neck of the vessel can be formed with a socket, into which a stopple on the tube *a* can be forced and the joint made light by a mercury seal above the stopple; or this arrangement can be reversed and the mercury seal dispensed with. The glass tube *a* is a branch from or is connected with a pipe, *d' m*, the portion *m* of which is connected with an air-pump, B, by means of a joint, *b*. This joint *b* is of the usual construction of joints in apparatus of similar character to this, and is composed of a stopple on the tube *m*, setting into a cup. A mercury seal may be used above the stopple.

The branch *m* is provided with cock *c*, for cutting off or turning on the connection between the pump and vessel A, and a gage, C, may be provided to indicate the degree of exhaustion produced by the pump.

The branch *d'* is connected with a mercury drop or Sprengel pump, of ordinary construction. This is shown as composed of the mercury-trough G, the receiver F, from which the mercury is raised to G, drop-tube D, tube *e*, branch *d*, tube E H, and gage *f*.

The air-pump is used as an auxiliary to commence the exhaustion, in order to save time; but if the vessel A is of small capacity and nearly filled with some substance, the mercury-drop can alone be used. The vessel A, containing the articles or article, being connected with glass tube *a*—as for example, by fusing the tube to the neck of said vessel—the cock *c* is opened and a partial vacuum produced by the air-pump. The cock *c* is then closed and the exhaustion continued by means of the Sprengel pump. When the desired high vacuum has been reached the connection with the air-pump, preferably at the juncture of the

tube *a* and neck of vessel A, is fused by a blow-pipe, and the vessel A is gradually drawn away from the tube *a*, the separation taking place at the point of fusion, and the vessel being twisted or turned around so as to hermetically close the neck of the vessel. The seal can then be made more perfect, if desired, by the further fusion and working the glass, the complete vessel having the appearance shown in Fig. 2. Another vessel A is then connected with tube *a*—for example, by the fusion of the glass tube to the neck of the vessel—and the operation just explained is repeated.

What I claim is—

1. The method of putting up organic substances for preservation and transportation, consisting in placing them in a glass vessel, producing a high vacuum therein, and then hermetically closing the vessel by sealing off the channel to the air-pump, the envelope produced being essentially a homogeneous piece of glass.

2. As a new article of manufacture, a highly-exhausted glass vessel containing an organic substance sealed therein by the fusion of the glass, the enveloping-vessel being essentially a homogeneous piece of glass, substantially as set forth.

This specification signed and witnessed this 11th day of December, 1880.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

WM. CARMAN.

(No Model.)

2 Sheets—Sheet 1.

T. A. EDISON.

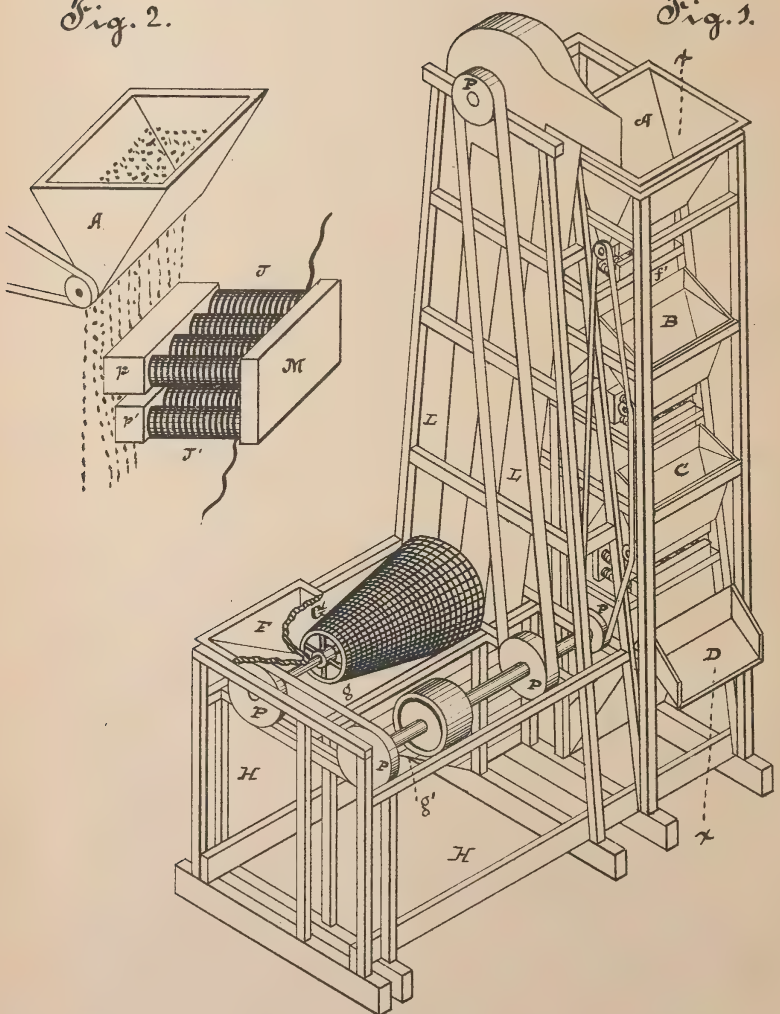
MAGNETIC SEPARATOR.

No. 248,432.

Patented Oct. 18, 1881.

Fig. 2.

Fig. 1.



Attest:

S. D. Mott

F. H. Hall

Inventor:

Thos. A. Edison.

by Dyer & Wilber

Attys

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.)

2 Sheets—Sheet 2.

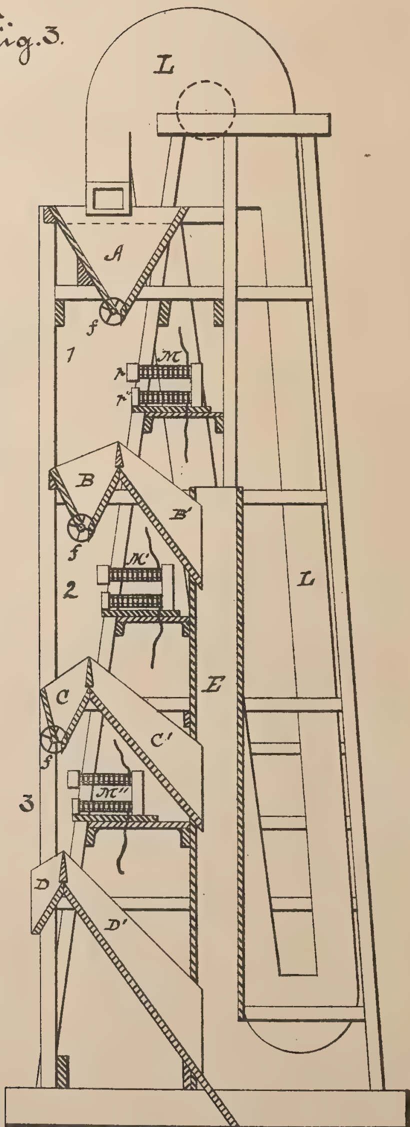
T. A. EDISON.

MAGNETIC SEPARATOR.

No. 248,432.

Patented Oct. 18, 1881.

Fig. 3.



Attest:-
D. D. Mott
F. H. Hall

Inventor:-
Thos. A. Edison
by Dyer & Wilber
Atty's

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO EDISON ORE MILLING COMPANY, (LIMITED,) OF NEW YORK, N. Y.

MAGNETIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 248,432, dated October 18, 1881.

Application filed August 6, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Magnetic Separators; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In Letters Patent of the United States, No. 228,329, granted me June 1, 1880, is shown a device for separating magnetic and non-magnetic substances, consisting, essentially, of a magnet past whose poles fall the mingled substances, the attraction of the magnet acting to alter the path of the magnetic substance, drawing it out and away from the non-magnetic portion, the magnetic and non-magnetic substances falling into different receptacles.

The invention in this case relates to improvements upon the invention therein shown; and it consists in the features more particularly hereinafter specified and claimed.

In this invention U-shaped electro-magnets are used, made up of one or of several series of coils. Where several series of coils are used their polar faces or extensions are united to form one polar face or extension for one polarity, the polar faces being placed at right angles to the flow of the material to be treated. The magnetic material is acted on consequently by both poles. As the first draws it out of its path, if the second were in the same plane relatively to the flow of material, it would act on the material at a shorter distance than the first, and would possibly attract the material to itself. To avoid this it is better to place the active faces of the polar extensions in different planes relatively to the flow of material, the second being placed to the rear of the first, a distance approximately equal to the distance the first draws the magnetic material out of its path. From the fact that often a particle or particles of non-magnetic substance come between particles of the magnetic substances and the attractive force acting on them, such magnetic particles are not drawn out of their path sufficiently, and fall with the non-magnetic substances; hence it is preferable that the material be subjected to the action of the separator several times in order to insure thorough separation. As some portion of the substance to be treated is more magnetic than another, this more magnetic portion is apt to be drawn out of its path and separated by the first separator. Moreover, if the magnets be too near the path of the very magnetic material, they would be apt to draw the material to themselves, which, clinging thereto, would soon clog the magnets, constantly extending their poles; hence the magnets of the first separator are placed at some distance from the path of the material. In order, then, to act equally on the less magnetic portion, it is preferable that the next set of magnets be placed somewhat nearer the path of the falling material, and so with each succeeding separator of the series. To accomplish this, several—preferably three—separators are arranged in series, somewhat in echelon, so that the portion which passes into the non-magnetic receptacle of the first passes immediately to the second separator, and so on through the series, the magnetic receptacles of all the series leading to a common delivery-chute. Combined with this series is a suitable hopper and sieve and elevator for carrying the sifted material up and delivering it to the first separator of the series.

In the drawings, Figure 1 represents a series of separators and accessories mounted in a suitable framing; Fig. 2, a single hopper and magnet in detail; and Fig. 3, a series of magnetic separators in section, taken on line x x of Fig. 1.

H H H, &c., is any suitable framing, in which are secured the separators 1 2 3, each consisting, essentially, of a hopper and magnet, as A M, B M′, and C M″.

The material to be treated is first fed into a hopper, F, whence it passes into a sieve, G, as all lumps, stones, &c., should be separated from the material to be treated. The sifted material falls into a receptacle, g, having an inclined bottom, g', which feeds it into the bottom of an elevator, L, while the lumps, stones, &c., from G are delivered to a wasteway. (Not shown.) The elevator L conveys the material to the hopper A of the first separator, whence it falls in front of the magnet M. Below M is a hopper, B, receiving the less and the non-mag-

netic portion and passing it before the second magnet, M′, the magnetic portion falling into B′ and thence into the delivery-chute E. Below M′ is a similar hopper, C, passing the less and the non-magnetic material before M″, and the passage C′ passing the magnetic portion into the delivery-chute E. This construction and relation are repeated until as many separators as may be desired are arranged in the series.

It will be noticed that each succeeding magnet is set nearer the path of the material than its predecessor in the series. For instance, M″ is nearer such path than M′, and M′ than M.

It will also be noticed that the active faces of the lower polar extension of each magnet are set back a short distance from that of the upper polar extension, this distance being approximately equal to the distance the latter draws the magnetic material out of its path.

Motion is communicated to the various portions of the series by means of belts and the pulleys P P, &c.

When desired, it is evident that the elevator may be dispensed with and the sifted material be conveyed to the hopper of the first separator in any convenient manner.

What I claim is—

1. In an electro-magnetic separator, a magnet having its poles or polar extensions or faces in different planes relatively to the path of the material to be treated, substantially as set forth.

2. The combination of a series of magnetic separators acting successively upon the same stream of material and arranged to change the trajectory of the magnetic portion of the falling material without stopping its fall, and a series of hoppers acting as hoppers and waste-chutes, the hopper of one separator being the waste-chute of another, substantially as set forth.

3. The combination of a series of magnetic separators, each arranged to change the trajectory of the magnetic portion of the falling material without stopping its fall, such magnetic separators being located successively nearer the path of the material to be acted on, substantially as and for the purpose set forth.

4. The combination of a sieve, an elevator, a series of electro-magnetic separators, constructed substantially as shown, and a single delivery-chute, substantially as set forth.

This specification signed and witnessed this 26th day of July, 1880.

THOS. A. EDISON.

Witnesses:

WM. CARMAN,

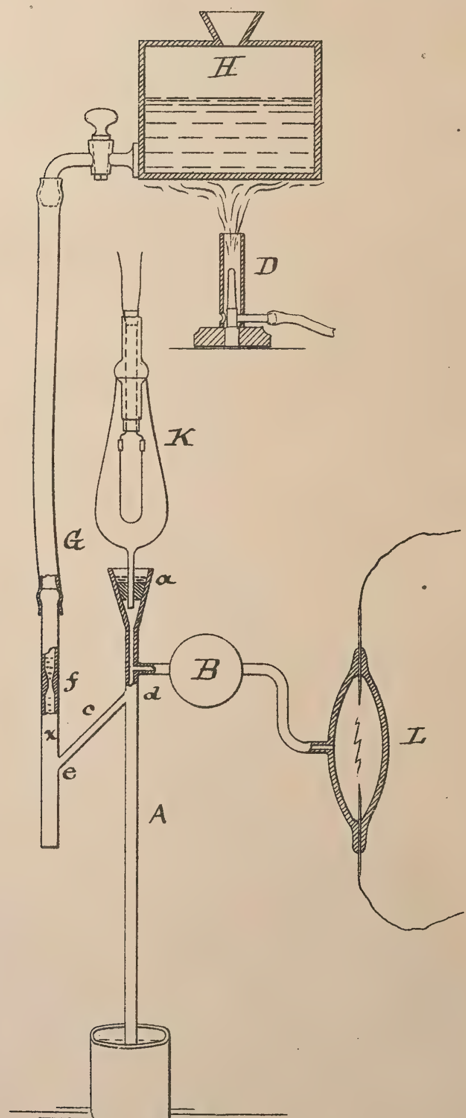
S. D. MOTT.

(No Model.)

T. A. EDISON.

VACUUM APPARATUS.

No. 248,433. Patented Oct. 18, 1881.



Attest.

Chas. Raettig.

S. D. Mott

Inventor.

T. A. Edison.

pr. Dyer and Wilber

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

VACUUM APPARATUS.

SPECIFICATION forming part of Letters Patent No. 248,433, dated October 18, 1881.

Application filed January 31, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Vacuum Apparatus; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This invention relates to improvements in the vacuum apparatus known as the "Sprengel drop-pump," and to methods and means of treating the mercury employed therein, the object being to increase the efficiency and reliability of the apparatus.

The Sprengel drop, as hitherto made, consisted of a single drop-tube connected to a reservoir of mercury, and having a contraction or strangulation, so that the flow of the mercury was checked, its stream being broken into drops. To this drop-tube was connected the body to be exhausted, and also such testing as was desired. Sometimes, however, from different causes, a globule of air would pass down this drop-tube, the result being the impairment of such vacuum as had already been attained.

The object of this invention, therefore, is to prevent such result; to which end it consists in using two drop-tubes, the first one connected to the reservoir and provided with the contraction or strangulation, the second connected to the body to be exhausted, and to whatever testing devices are used, the two being connected by a tube inclined upwardly from the first to the second, so as to form a trap-seal between the two. The result of this is that two vacuous spaces are formed, separated by a solid column of mercury. Now, if a globule of air enters the vacuum apparatus, it is caught in the first vacuous space, impairing its tension, while the second vacuous space, which, from its inclusion of the body to be exhausted, is the important one, is protected.

In the drawings, Figure 1 is a sectional view of my improved Sprengel pump, and Fig. 2 a sectional view of the mercury-filter.

H is a mercury-reservoir, in which the mercury is to be kept at a minimum temperature of, say, 100° or 110° Fahrenheit, these figures being approximate ones only, as it is evident that a variation of a few degrees either way would accomplish the result arrived at. This heating may be effected in any desired manner—say by a steam or water jacket, heated coils, or by the direct application of fire-heat—the gas-jet D being merely typical, as this subject-matter is set forth and claimed in a separate application.

G is the first drop-tube, connected to the reservoir, and provided with the contraction or strangulation *f*. A is the second drop-tube, to which is connected the body to be exhausted, here represented by the lamp K, secured thereto by its open tube passing through the mercury-sealed stopple in the enlarged end *a* of A. Connected to A is the bulb or other receptacle, B, which may contain a mixture of sodic hydrate and phosphoric anhydride or other drying agent, and the Geissler or spark tube L, for indicating the degree of exhaustion. The drop-tubes A and G are connected by the tube *c*, which inclines upwardly from G to A. The mercury, in passing through G, has its flow checked at *f*, and forms a vacuous space, (marked *x*,) and rising in *c* it trickles over at *d* and falls through the drop-tube A. The connecting-tube *c* is always full of mercury, preventing any access of air from G to A. Hence if air by any means finds its way into G, it simply impairs the vacuum in *x*, that in A and K being preserved and maintained at a higher tension than that in *x*.

What I claim is—

1. The combination, in a Sprengel or drop pump, of two drop-tubes connected by a sealing-tube, substantially as shown and described.

2. In a Sprengel or drop pump, a drop-tube connected to a reservoir and provided with a contraction, and a separate drop-tube connected to the body to be exhausted and to the first drop-tube, substantially as set forth.

This specification signed and witnessed this 19th day of January, 1881.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
ERNEST J. BERGGREN.

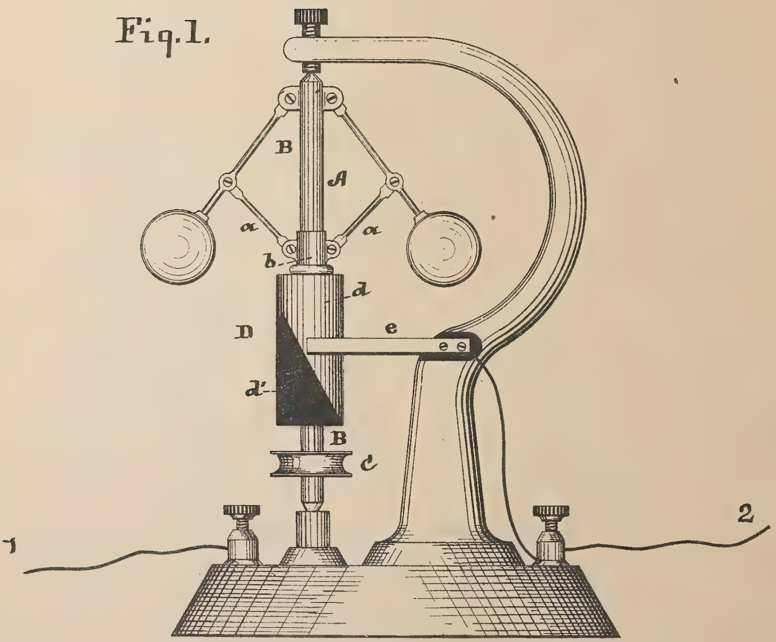
(No Model.)

T. A. EDISON.

GOVERNOR FOR ELECTRIC ENGINES.

No. 248,434. Patented Oct. 18, 1881.

Fig. 1.



ATTEST:

S. D. Mott

E. Berggren

INVENTOR:

Thos. A. Edison

per Dyer & Wilber

ATTORNEYS.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

GOVERNOR FOR ELECTRIC ENGINES.

SPECIFICATION forming part of Letters Patent No. 248,434, dated October 18, 1881.

Application filed August 9, 1880. (No model.) Patented in Canada, March 31, 1881.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Engines; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

This invention relates to a governor for electro magnetic engines.

Governors, as usually hitherto made for such engines, have been arranged to break the circuit upon the occurrence of a too great speed, the circuit being again closed upon the proper lessening of the speed; but it is evident that the abnormal speed will be continued by the momentum of the parts for a greater or less interval after the breakage of the circuit. This plan gives rise to undesirable variations in the speed of the engine, as the speed must first rise when the circuit is broken, then fall when it is again completed, thus alternating in rise and fall of speed, often giving a jerky motion to the engine and connected gearing. The better plan would seem to be to so arrange the governor that ordinarily the abnormal or greater than desired speed should not be reached, the speed being maintained practically uniform.

The object of this invention is to accomplish this result; and to that end it consists in a governor by which the circuit is broken at regular intervals—that is, once in every revolution of the governor—and ordinarily at a certain determined point, the engine running by momentum until the circuit be again completed, thus, so to speak, allowing the current to act through only a portion of the stroke, cutting it off then, after a manner analogous to the cutting off in steam engines, the governors being also so arranged that as the speed increases the current shall be cut off and the engine run by momentum a proportionately longer time during each revolution, forming a variable automatic cut-off exactly analogous to the steam-engine cut-off.

In the drawing the figure illustrates such a governor.

A is a centrifugal ball-governor, composed of two balls attached to the fly-rods, which are pivoted in supports fixed upon the shaft B, which is mounted in suitable bearings and receives motion by means of a cord or belt passing around the pulley C and connecting it to some moving part of the engine.

The arms *a a* of the governor are pivoted to a sleeve, *b*, to which is attached a commutator, D, both arrranged to slide up and down upon the shaft B. The commutator D is made of a conducting portion, *d*, and insulating portion *d'*, each cut diagonally and united at their diagonal edges. The circuit to the engine passes by conductor 1 to the shaft B, then by the conducting portion *d* to spring *e*, supported on but insulated from the frame of the governor, and thence to 2. The governor is so adjusted that upon rotation at the proper speed and with the proper pressure of current the commutator will be in the right position for the circuit to be complete during enough of each rotation of D to maintain uniform such speed. As either additional work is given the engine to do or less current is supplied, the governor slowing will cause the current to be on for a greater portion of the rotation, or, so to speak, will cut off at a great fraction of the stroke, or vice versa.

What I claim is—

1. A governor for an electric engine arranged to break the circuit at regular definite intervals, consisting of a rotating contact-maker, constructed as described, with means for automatically imparting thereto a longitudinal movement, and a contact-spring bearing thereon and interposed in the motor circuit, substantially as set forth.

2. A governor for an electric engine, consisting of a rotating contact-maker constructed as described, and arranged to break the circuit during every revolution of the governor at a point in and for a fraction of the revolution, dependent upon the speed of the engine, substantially as set forth.

This specification signed and witnessed this 31st day of July, 1880.

THOS. A. EDISON.

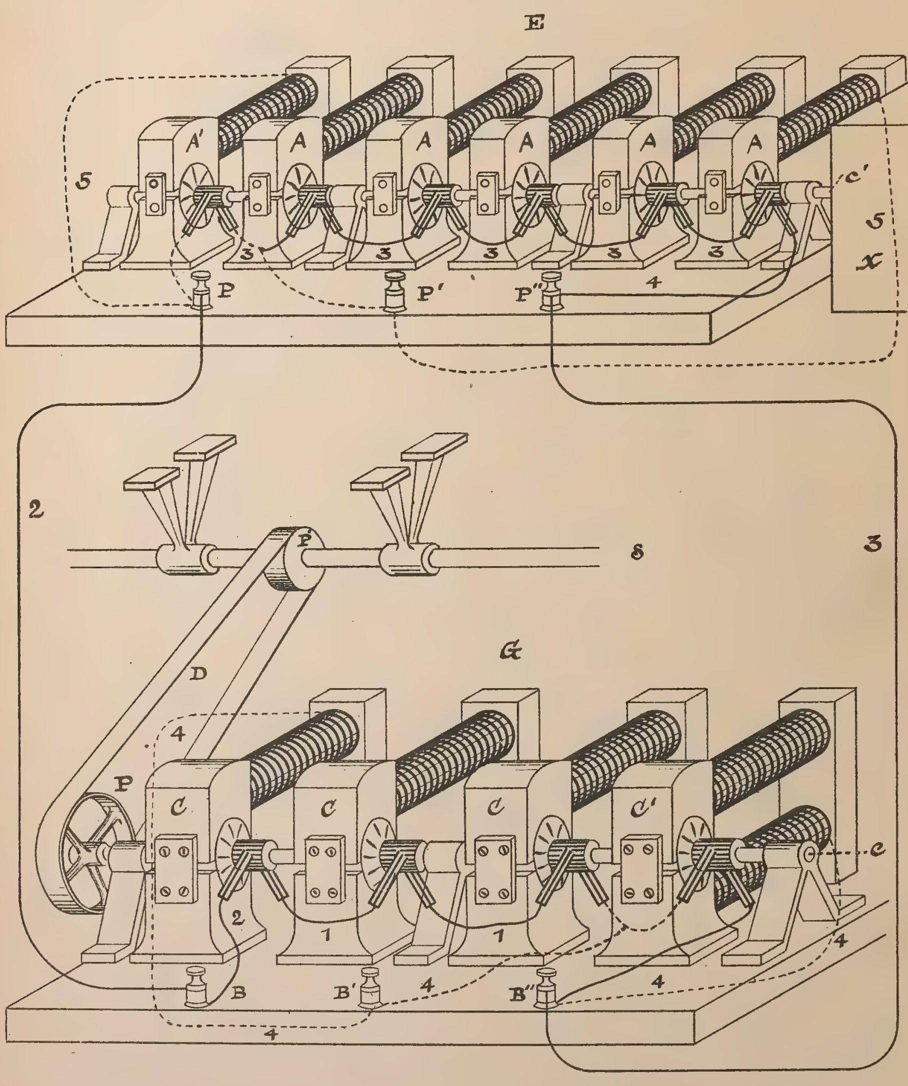
Witnesses:
WM. CARMAN,
S. L. GRIFFIN.

(No Model.)

T. A. EDISON.

UTILIZING ELECTRICITY AS A MOTIVE POWER.

No. 248,435. Patented Oct. 18, 1881.



Attest:
S. D. Mott
J. F. Randolph.

Inventor:
Thos. A. Edison
per Dyer and Wilber
Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

UTILIZING ELECTRICITY AS A MOTIVE POWER.

SPECIFICATION forming part of Letters Patent No. 248,435, dated October 18, 1881.

Application filed October 1, 1880. (No model.) Patented in Canada March 31, 1881.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Method of and Means for Utilizing Electricity as a Motive Power; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

Some method by which power could be readily and economically transferred to a distance from a prime motor has long been felt to be desirable, and to that end many suggestions have been made and plans devised involving its transfer by ropes, by compressed air, and by electricity. Practically it has been determined that the power of a prime motor may be converted into electricity and the electricity conveyed to a distance, to be retranslated into power, this, however, only to a limited extent and by the use of very large conductors; for to transmit power to any great distance without the use of large and costly conductors requires that the current should have very great electro-magnetic force or "pressure"—say as much as two to three thousand volts. In practice, with magneto or dynamo electric machines as now built, it is impracticable to generate currents of such high electro-motive force. These machines have but a single bobbin, and the difference of potential between one section of wire upon the bobbin and another would be very great. Against so great a difference of potential it is extremely difficult to guard, even by the most careful winding and insulation. The result, especially in damp weather or when the bobbins become damp, is that the currents break a short path from section to section, burning the wires. In addition, such great electromotive force causes a large increase of destructive spark at the commutators. If currents of such electro-motive force could be safely and economically generated and translated, exceedingly small and inexpensive conductors, relatively, could be used to transfer, without material loss, a very large amount of power—say several hundred horse-power.

One object of this invention, then, is to furnish means and methods by which this transmission may be made. To accomplish these results a battery of generators is used, each separate and complete in itself, but with all the rotating armatures or bobbins (each provided with its own commutator) mounted upon the same driving-shaft, the total electro-motive force of all the bobbins being equal to the electro-motive force desired. By thus dividing it between a number of bobbins it is lessened in each bobbin, with a consequent reduction of difference of potential between the layers or sections on each bobbin. The motors or retranslating-engines are divided up in the same way, all the bobbins, each having its own armature, being mounted upon the one driving-shaft, upon which they all exert their force.

By the arrangement thus generally stated it is possible and commercially practicable to convert even several thousand horse-power of a prime motor into electricity, convey the electricity by moderate-sized or even small conductors to a distance, there to be reconverted into power. In addition I have discovered that for the best results certain relations must exist between the generators and engines.

In using generators to produce a current which is supplied to an electric-engine, the practice hitherto has been to make the generator or transmitting-machine and the engine or receiving-machine exactly alike, so that when each is rotating at same speed the contrary electro-motive force of the receiver exactly equals the electro-motive force of the generator. In such cases, when no work is being done, the tendency of the engine or receiver is to acquire that rate of speed which is necessary to make the counter and prime electro-motive force about equal. As work is given the engine to do, its speed, and consequently its counter electro-motive force, is reduced; but where both are made alike and have, when doing no work, equal forces, it has not been found desirable to load the engine or receiver beyond the point reducing its speed, and consequently its counter electro-motive force, more than one-half. The difference between the electro-motive force and the counter electro-motive force (of course, less friction, &c.) rep-

resents the amount of current transferred into power, which in most cases is not more than fifty per cent.

Instead of the arrangement described, I wind the bobbins of the receiving machines or engines, so that when driven at the same speed as the generators or transmitters their counter electro-motive force shall be about one-half that of the transmitters. This is accomplished by winding the engine or motor bobbins with a wire coarser and of less length, either or both, than that used in the generator-bobbins. The consequence is that less wire cuts the lines of force in the engine or motor than in the generator upon each rotation of the bobbins. Consequently to have the same amount of wire cut the lines of force in both cases the engine or motor bobbins must be rotated at much higher speed. Unloaded, then, as their tendency is to run at the rate which shall develop the same electro-motive force, they rotate at twice the speed of the generators. Now, if they are so loaded with work as to reduce their speed to the same as that of the transmitters, they develop only half their unloaded counter electromotive force, turning fifty per cent. into power at that rate. It is preferable to load the engines with work only to that point which permits of a speed not less than that of the generator, and usually somewhat greater, so that the counter electro-motive force developed shall be about seventy-five per cent. of the prime electro-motive force, at about which point is the greatest economical conversion into force. In connecting up the generators and engines the same plans may be followed in both.

As stated in a previous application, but a small current is required to keep up to the point of magnetic saturation field-magnets once brought to that point. When all the current generated is taken through the coils of the field-of-force magnets there is many times as much current as is needed for the purpose, and the resistance of the field-coils is uselessly added to the circuit of the current. Consequently I prefer to use only a part of the current, arranging a shunt-circuit to the bobbin of one or all the machines, which shunt passes around and energizes the fields of the whole series. The resistance of the fields is proportional to the electro-motive force of the bobbin, so that only the proper proportion of current will pass through the shunt—that is, just enough to keep the field-magnets up to the point of economical magnetic saturation.

In the drawing is shown the arrangement described as far as may be shown in a drawing.

E is a battery of generators, which may be of any desired number, six, A A A A A A′, being shown, their rotating armatures or bobbins and commutators being upon a shaft, c', common to them all, which is driven from any suitable prime motor, (represented arbitrarily by x.) In this case the bobbins of the entire battery are connected in a series by wires 3 3, extending from the commutator-brush of one generator to that of the next, conductors 2 3, attached to the terminal binders of the battery, leading to and from the battery G of engines or translating devices. From the commutator-connections of A′ a shunt-circuit is formed, 5 5, which passes through the coils of all the field-of-force magnets of the series.

G is a battery of engines or receivers, C C C C′, having bobbins wound, as explained, so as to have, when doing no work, a speed of twice that of the bobbins of the generators, in order to develop a counter electro-motive force equal to the electro-motive force of the generators. The bobbins and commutators are placed on a shaft, c, common to them all, which shaft is suitably connected to the machinery to be driven, which connection is represented in this instance by pulley P on shaft c, belt D, and pulley P′ on shaft S, which conveys the power to the driven machines. The current comes from the generators, say, by wire 2, passes to the commutator of the first engine C, thence by wires 1 1, through the commutators of the remainder in series, and by wire 3 back to generators. A shunt circuit, 4, to the commutator of C′ leads through the coils of all the field-of-force magnets, the resistances of the shunts in both instances being proportioned as hereinbefore explained.

Instead of the generators and engines being arranged in series, as shown, they may, if deemed desirable, be arranged, either or both, on the multiple-arc system, in which cases the relative resistances of the parts must be adjusted to compensate for the difference in resistance of the circuit inherent upon arrangement of devices in series or in derived circuits.

The engines of the battery G need not be located at one place, as shown, but may be distributed—as, for instance, through a village, which is remote from the source of supply or station where E is located. In such case a small dynamo may be placed in the circuit 2 at the village or locality and the current therefrom used to excite the field-magnets of the engines, a local circuit leading from and to the dynamo through all the field-coils of the engines there located.

Instead of the bobbins being wound differently, so as to require different speeds for the same electro-motive forces, the number of engines or receiving machines used may be less than that of the generators. For instance, as shown in the drawing, with six generators four engines may be used with the result, in order to give same electro-motive forces, that the receivers run with much greater speed than the generators.

What I claim is—

1. The combination of a magneto or dynamo electric machine and an electric engine, constructed relatively to each other so that the engine must run at a much greater speed than the magneto or dynamo electric machine to produce a counter electro-motive force equaling the electro-motive force of the dynamo or

electro magnetic machine, substantially as set forth.

2. The method of transferring power into electricity and reconverting the electricity into power, consisting in generating the current in dynamo or magneto electric machines, or in a battery thereof, giving at a certain speed a certain electro-motive force, transmitting the current to an electric engine or motor or series thereof, arranged to give the same electro-motive force, only at a much higher rate of speed, substantially as set forth.

3. The combination, with the main circuit of a series or battery of magneto or dynamo electric machines, used either as generators or receiving-machines, of a shunt-circuit to the bobbin or armature of one of the machines, which shunt passes around and energizes all the field-of-force magnets of the battery, substantially as set forth.

This specification signed and witnessed this 12th day of August, 1880.

THOS. A. EDISON.

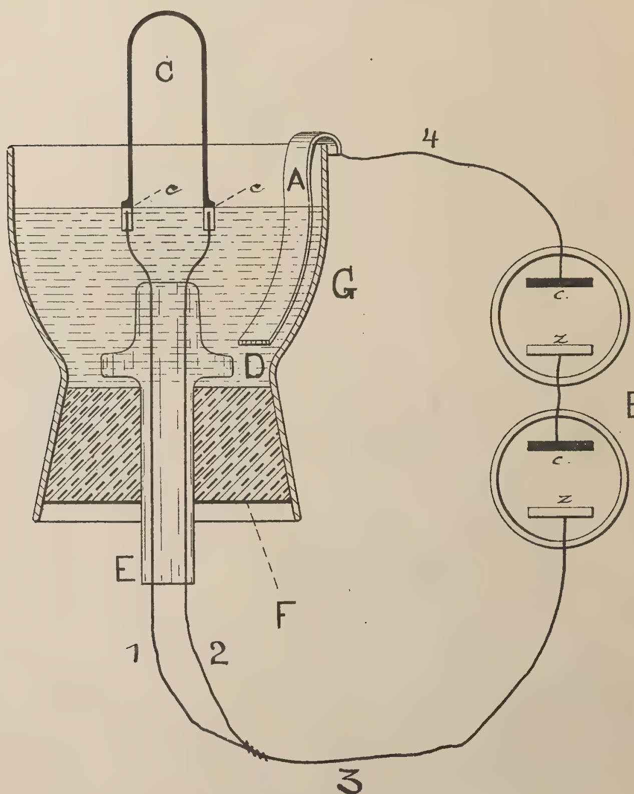
Witnesses.
C. P. MOTT,
WM. CARMAN.

(No Model.)

T. A. EDISON.

DEPOSITING CELL FOR PLATING THE CONNECTIONS OF ELECTRIC LAMPS, &c.

No. 248,436. Patented Oct. 18, 1881.



Attest:

D. W. Mott

H. W. Seely

Inventor:

T. A. Edison

per Dyer & Wilber Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DEPOSITING-CELL FOR PLATING THE CONNECTIONS OF ELECTRIC LAMPS, &c.

SPECIFICATION forming part of Letters Patent No. 248,436, dated October 18, 1881.

Application filed May 27, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Depositing-Cells for Plating the Connections of Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object I have in view is to produce a simple and efficient depositing-cell more especially designed for electroplating the connections between the carbon and the leading-in wires of an incandescing electric lamp, which cell will permit of the ready adjustment of the wire-support, so that the point of plating can be controlled. This I accomplish by providing the cell with a perforated stopple, made preferably of some yielding material—such as soft rubber—through which the glass wire-support is pushed from above, the stopple making a tight connection therewith. The cell is then filled to the desired height with the plating solution, and the glass wire-support is adjusted vertically in the stopple, so that the solution will not rise above the connections of the carbon and wires. The leading-in wires of the lamp are then connected with the zinc plate of a battery or with the negative pole of any other suitable generator, while the positive pole of the battery or other generator is connected with an electrode immersed in the solution, this latter electrode forming the anode of the cell while the connections of carbon and wires form the cathode. When the connections have been plated sufficiently heavy to make them secure the solution is drawn off, the wires disconnected from the battery, and the glass wire-support carrying the wires and carbon removed from the stopple. The leading-in wires from the points it is desired to plate down to the top of the glass support may first be covered with varnish, wax, or some other substance to prevent deposition thereon, or they may be left uncoated and deposition proceed thereon. This cell can be multipled to any desired extent, so that a large number of connections can be plated at the same time, a yielding stopple being provided for each glass support.

In the drawing the figure represents a vertical section of the depositing-cell with the glass wire-support in position therein.

G is the depositing-cell, made open at the bottom or having an opening of sufficient size made therethrough, a rubber or other suitable stopple, F, being used to close the orifice.

E is the glass supporting-tube, such as is used in my lamps to receive the conducting-wires 1 2, which are sealed therein, the tube being provided with the enlargement D, for sealing into the neck of the inclosing globe or bulb of the lamp. At their upper ends the wires 1 2 are secured to the carbon C at the enlarged or clamping ends *c c* by any desirable means—as, for instance, by flattening out the wires at their ends and wrapping them around the carbon. The tube E is then passed through the aperture in the stopple F, the wires below the connections being covered with varnish, wax, or other substance preventing deposition thereon. The cell is then filled to the desired height with the plating solution, as shown, and the tube is adjusted vertically in the stopple, so as to bring the connections to the surface of the solution. Connections 3 4 are then made to the wires 1 2, and to the plate from any suitable source of electricity, a battery, B, being, for ease of illustration, shown in the drawing. The plate A forms the anode, and the ends *c c* the cathode, of the depositing-cell. In multiplying this cell a shallow tank can be provided with a large number of perforated elastic stopples, each adapted to receive one of the glass wire-supports, which, after the solution is poured into the cell, are all adjusted to the proper height. The connections of 1 and 2 of all the carbons are then made with a source of electricity and the connections of carbon and wires plated. The solution is drawn off from the tank before the glass supports are removed from position in the stopples.

I do not claim herein the method described of securing the wires to the carbon or the combination of the carbon and wires secured in this manner, the same being the subject-matter of an application before filed by me.

What I claim is—

1. An electroplating-cell provided with a perforated bottom for receiving the support of the article to be plated, and allowing the adjustment of such support through said bottom, so that the point of plating may be controlled, substantially as set forth.

2. An electroplating-cell provided with one or more perforated elastic stopples for receiving the supports of the article or articles to be plated, substantially as set forth.

This specification signed and witnessed this 17th day of May, 1881.

THOMAS A. EDISON.

Witnesses:
Wm. H. Meadowcroft,
H. W. Seely.

(No Model.)

T. A. EDISON.

APPARATUS FOR TREATING CARBONS FOR ELECTRIC LAMPS.

No. 248,437. Patented Oct. 18, 1881.

Fig. 1.

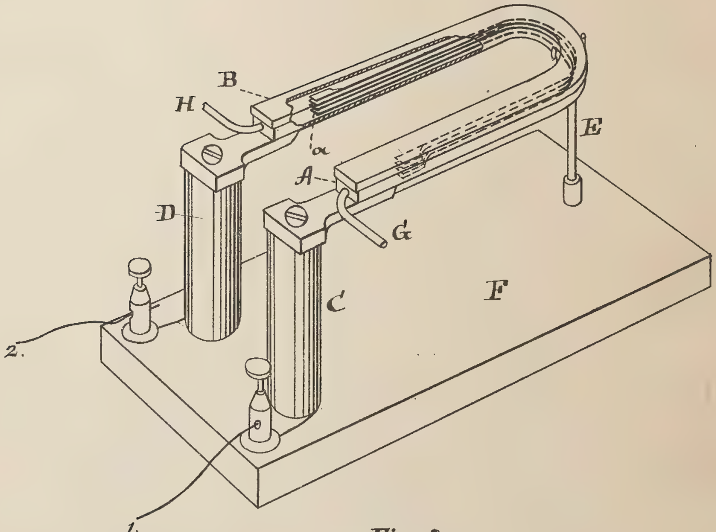


Fig. 2.

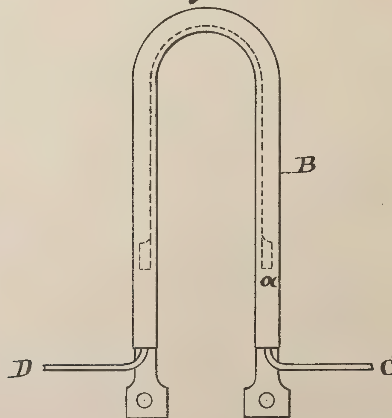
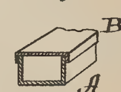


Fig: 3.



Witnesses:

Chas. Raettig.

S. D. Mott

Inventor:

T. A. Edison.

pr

Attys.

N. PETERS. Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

APPARATUS FOR TREATING CARBONS FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 248,437, dated October 18, 1881.

Application filed January 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Carbons for Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In a system of lighting by electrical incandescence it is necessary that all the incandescing conductors of a series should be as nearly as possible of the same resistance. These incandescing conductors are made from strips of paper or other suitable substances, which are cut into the proper shape and carbonized in such a manner that they will retain their shape. After they are finished it is found sometimes that they vary in resistance, and it is therefore necessary to reduce the resistance of some, in order that they may all be alike. The larger the carbon or the greater its mass the lower its resistance, and consequently the way to reduce the resistance is to increase either the size of the carbons or their mass, or both. To do this I first test the resistance of various carbons when cold and find those in which it is lowest. The others must be reduced to nearly the same point. This is done by heating them while they are exposed to a carbon compound in a gaseous state, which will be decomposed by the heat and will deposit other carbon on the carbon filaments until their size or mass is increased and their resistance diminished to the proper point.

A convenient apparatus for this purpose is shown in the accompanying drawings, Figure 1 being a perspective view thereof; Fig. 2, a plan or top view; and Fig. 3 an end view of the mold or flask in which the carbons are placed.

A is a flask or vessel made of nickel, platina, or carbon, (the last being deemed preferable, because it can be made of paper and carbonized into the proper shape,) having a tightly-fitting cover, B, a portion of which in the drawings is broken away to afford a view of the carbons *a*. The mold is supported on pillars C D E, which rest on a suitable base, F.

G H are pipes, through one of which vapor is admitted to the carbons *a* and is removed through the other. The carbons being placed in the flask, as shown, an electric current is passed through the wires 1 2, the pillars C D and the flask A, heating the flask, and consequently the carbons, to a very high temperature. The carbon vapor is then allowed to enter the pipe, and, circulating around through the flask, deposits carbon on the heated filaments until their resistance becomes sufficiently reduced.

The time necessary for the operation may be determined by experiment, carbons originally of high resistance requiring a longer time than those of greater conductivity. Afterward the cover is taken off and the carbons removed, when the flask may be used again for other carbons.

It is not essential that the gas should be passed through the flask, as shown, by means of pipes; but instead, crystals of naphthaline or other carbon compound of similar nature may be placed in the flask, and when it is heated they will vaporize and deposit their carbon upon the filaments; or the cover B may be dispensed with and the flask placed in a receptacle filled with the vapor, the carbon of which will be deposited upon the filaments when they are heated.

What I claim is—

1. A flask or vessel adapted to contain carbon for treatment, as described, and provided with circuit-connections, whereby it may be heated to incandescence by an electric current, substantially as set forth.

2. A vessel or flask adapted to contain carbons for treatment, as described, provided with means for passing therethrough a stream of vapor, and circuit-connections, whereby it may be heated to incandescence by an electric current, substantially as set forth.

This specification signed and witnessed this 21st day of December, 1880.

THOS. A. EDISON.

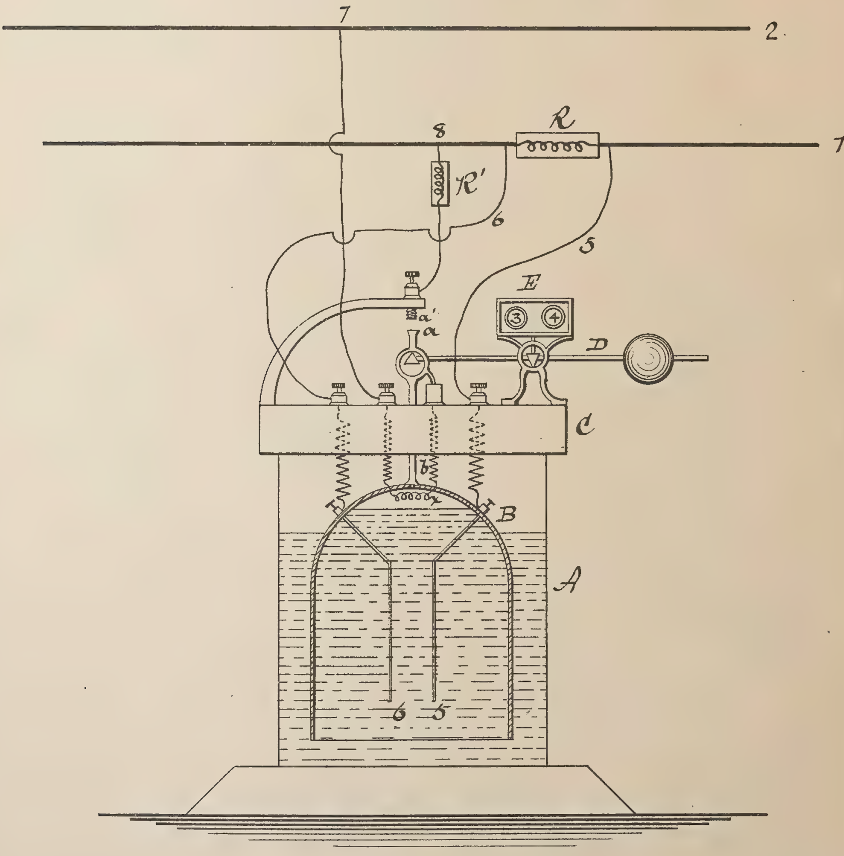
Witnesses:
H. W. SEELY,
ERNEST J. BERGGREN.

(No Model.)

T. A. EDISON.

WEBERMETER.

No. 248,565. Patented Oct. 18, 1881.



Attest:

S. D. Mott

H. W. Howard

Inventor:

Thos. A. Edison

per Dyer & Wilber

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

WEBERMETER.

SPECIFICATION forming part of Letters Patent No. 248,565, dated October 18, 1881.

Application filed December 15, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Webermeter; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

My invention relates to apparatus for measuring an electric current, and belongs to the general class of apparatus to which I have applied in a prior application the name below noted.

My arrangement for this purpose consists in deflecting a definite proportional part of the current to be measured and passing it through a vessel partially filled with water and floating in the same liquid. The water in the vessel is decomposed by the current, and the gases formed displace a portion of the water in the vessel, lessening its specific gravity and causing it to rise. The rising of the vessel causes the lifting of a lever connected with a registering mechanism, so that, the amount of gases produced being proportional to the current passing through the vessel, and this in turn proportional to the main current, the last may be indicated by the register. Such arrangement is made that when a definite predetermined amount of decomposition has taken place the vessel will rise to a sufficient height to close an electrical circuit which will send a current through the gases and explode them, so that they will be recomposed into water and the vessel again fall, these operations being repeated so long as current passes.

The accompanying drawing is a sectional view of a form of my invention.

A is a tank of water, and B a vessel, also containing water, floating therein.

1 2 is the main circuit, from which, by means of a resistance placed at R, a definite portion of the current is deflected into the circuit 5 6. This circuit passes through the water in the vessel B, and returns again to the main circuit.

7 8 is a third circuit from the main one, and is broken at the contact-points a a'.

C is the top of the tank A. It supports a suitable registering apparatus, E, and the contact a, and the wires of the circuits 5 6 and 7 8 pass through it. Also passing through C is the projection b, which extends up from the vessel B, operating the lever D of the registering apparatus, and terminating in the contact-point a.

As above stated, in consequence of the resistance R a definite portion of the current is deflected from the main current into the wire 5, and passes down through C into the vessel B. The lower portion of this circuit 5 6 is completed by the water, and the current, in passing through it, decomposes a portion thereof, which rises in a gaseous form to the surface. As the upper portion of the vessel becomes filled with these gases the specific gravity of the whole is lessened and the vessel rises, carrying with it the projection b, and thus moving the lever D, which operates the register. When the upper part of the vessel B is entirely filled with the gases it rises to such a height that the contact a will meet a' and close the circuit 7 8. A current of electricity immediately passes along this circuit, heating the platinum coil x and causing, by explosion, the recomposition of the gases into water. The vessel B then falls to its former position, reopening the circuit 7 8, and the electricity again passes through the circuit 5 6. This operation is, of course, continually repeated. A resistance placed at R′ prevents the passage of too large a current of electricity through the circuit 7 8.

What I claim is—

1. In a webermeter, the combination of a floating electrolytic cell, means actuated thereby for causing the recomposition of the water decomposed therein, and means for registering the rise and fall of the floating cell, substantially as set forth.

2. The method of measuring an electric current consisting in registering the rise and fall of a floating electrolytic cell, through the fluid of which a definite proportion of the current passes, substantially as set forth.

This specification signed and witnessed this 3d day of December, 1880.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

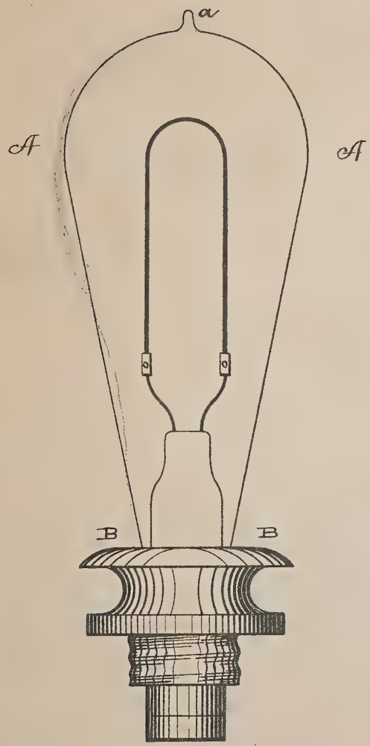
S. D. MOTT.

DESIGN.

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 12,631. Patented Dec. 27, 1881.



Attest:

S. D. Mott

F. W. Howard

Inventor:

Thos. A. Edison

per Dyer & Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DESIGN FOR AN INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Design No. 12,631, dated December 27, 1881.

Application filed November 30, 1880. Term of patent 14 years.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented and produced a new and original Design for Incandescent Electric Lamps, of which the following is a specification, reference being had to the accompanying drawing, which is a sectional view of a lamp constructed according to my design.

Heretofore the glass globes used to inclose the carbons of incandescent lamps have been made either of a spherical shape or in the form (when viewed in section) of an ellipse elongated at the ends.

The leading feature of my design consists of having the upper portion of the globe of the form (when viewed in section) of a semicircle and the lower part gradually tapering down to the bottom, where it is set into a socket. The widest portion of the globe is from A to A, and the form of the globe above these points is a half-sphere, except where it is broken by the projection *a*, which is occasioned by the breaking off of the stem of glass remaining after blowing the globe. Below the points A A the diameter of the globe becomes smaller, until at the points B B, where it is set into the socket, it is less than one-half the diameter A A. It will be seen that the globe is thus approximately pear-shaped.

What I claim is—

The design for incandescent electric lamps, herein described and shown.

This specification signed and witnessed this 23d day of November, 1880.

THOMAS A. EDISON.

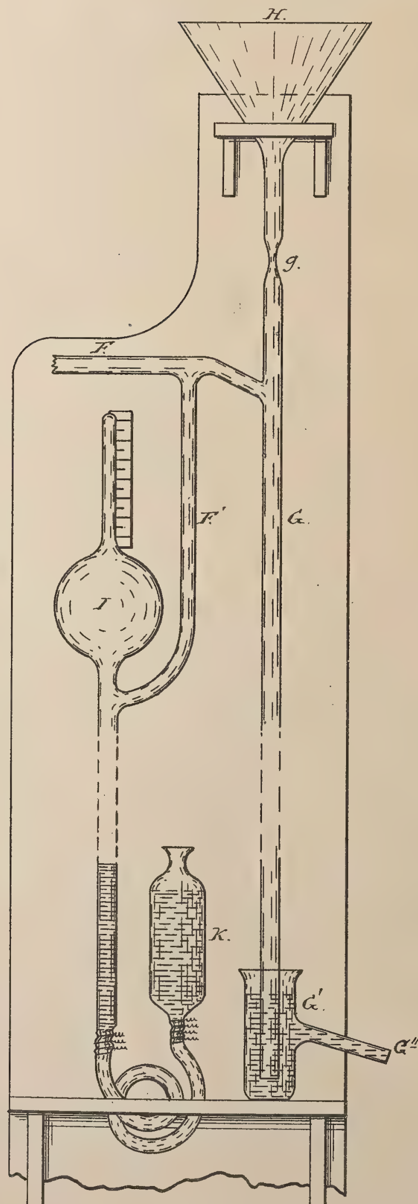
Witnesses:
H. W. SEELY,
ERNEST J. BERGGREN.

(No Model.)

T. A. EDISON.

VACUUM PUMP.

No. 251,536. Patented Dec. 27, 1881.



Attest;

F. W. Howard

J. Ells Clark.

Inventor;

T. A. Edison

Per Dyer and Wilber

Att'ys

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

VACUUM-PUMP.

SPECIFICATION forming part of Letters Patent No. 251,536, dated December 27, 1881.

Application filed December 7, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Vacuum-Pumps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

This invention has reference to improvements in the Sprengel air-pumps for producing high vacua; and it consists, essentially, in a contraction in the supply-tube formed integral therewith above the fall-tube.

In the Sprengel air-pumps heretofore in general use the mercury-supply tube and mercury-fall tube were connected by a rubber joint with a pinch-cock for regulating the size of the contraction in the rubber joint. More recently, in some instances, the pinch-cock has been dispensed with and a glass stop-cock used in lieu thereof. The pinch-cock and the glass stop-cocks have been found to be liable to leakage, the latter requiring an absolutely-true grinding of its parts—an expensive and difficult operation.

My invention is designed to avoid these objections, so that a pump capable of producing high vacua may be readily, certainly, and cheaply produced. Such a pump is illustrated in the drawing hereto annexed, which shows, in elevation, a pump embodying my invention.

As here shown, the pump proper is the long tube G, having at its upper end a mercury-reservoir, H, which may be integral therewith, as shown, or the upper part of G may be attached to a pipe leading from a reservoir supplying many pumps, as shown in Patent No. 248,425, dated October 18, 1881. At a little distance from its upper end the tube G is contracted into a narrow orifice, *g*, of a size permitting the mercury to pass therethrough drop by drop only. This contraction *g* takes the place of the rubber joint and of the glass stop-cock before referred to, and is formed integral with the supply-tube, the part of the tube above the end of the contraction being known as the "supply-tube" and the part below such point the "fall tube." At a little distance below *g* the tube F enters G, preferably by a downward bend, F being the tube to which is attached the article or vessel to be exhausted of air.

G′, as here shown, is a vessel for catching the mercury passing through the pump, and keeping the bottom of the tube or pump G sealed air-tight, the vent or overflow tube G″ being above the bottom or end of G.

Connected to F by a tube, F′, is a McLeod gage, I, for determining the degree of exhaustion.

What I claim is—

In a Sprengel air-pump, the mercury-supply tube having formed integral therewith a contraction above the fall-tube for regulating the flow of mercury, substantially as and for the purpose specified.

This specification signed and witnessed this 5th day of December, 1881.

T. A. EDISON.

Witnesses:
H. W. SEELY,
WM. H. MEADOWCROFT.

(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 251,537. Patented Dec. 27, 1881.

Fig 1

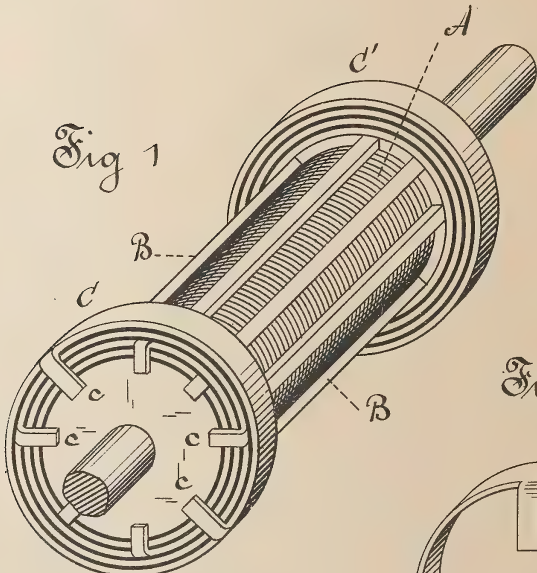


Fig. 3.

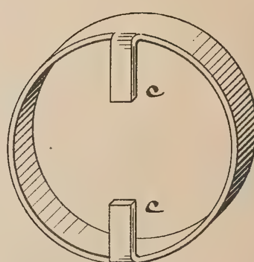
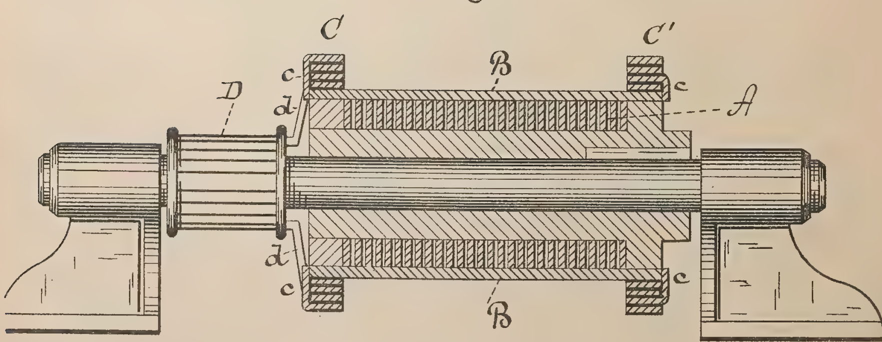


Fig. 2.



WITNESSES:

O. D. Mott

W. J. Clagett.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 251,537, dated December 27, 1881.

Application filed August 30, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines or Electric Engines; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce simple and efficient means for connecting the naked copper inductive bars in dynamo or magneto electric machines or electric engines having cylindrical armatures, the same being an improvement upon the means shown for this purpose in Patent No. 242,898, granted to me June 14, 1881. This I accomplish by the use of two series of concentric insulated rings, which make multiple-arc connections between the bars at each end of the armature, and at the commutator end are themselves connected with the bars of the commutator-cylinder.

In the drawings, Figure 1 is a perspective view of the armature without the commutator-connections, only a few of the copper bars and concentric rings being shown to avoid confusion; Fig. 2, a longitudinal section through the armature, the commutator-cylinder being shown in elevation; and Fig. 3, a separate view of one of the rings.

The core A of the armature is built up, as described in my former applications, of disks or rings of iron separated by paper.

B represents the naked copper bars, arranged longitudinally on the core parallel with the axis of rotation, and insulated from such core and from each other. In practice the core is wholly or nearly covered by such bars.

C C′ are the two series of concentric copper rings, located at the ends of the armature outside the polar extensions of the magnets, the rings of each series being insulated from each other. Each ring has two fingers, *c*, on its outer edge, which are bent inwardly for making connection with the inductive bars. At the commutator end of the machine each ring is connected with the bars of the commutator-cylinder D by an angular bar, *d*.

The connections of this machine are arranged symmetrically, preferably like those in the machine having a disk-armature, upon which I have already applied for a patent. At the commutator end each ring connects two opposite inductive bars, and has a connection midway with the commutator, while at the other end the terminal and initial bars of the pairs are connected symmetrically, so as to form a continually-closed multiple-arc circuit through all the bars, the current being divided at the negative commutator-brush, and each part passing through one half of the bars and meeting the other part of the current at the positive commutator-brush.

What I claim is—

1. In a dynamo or magneto electric machine or electric engine having a cylindrical armature, the concentric rings for connecting the inductive bars, substantially as set forth.

2. In a dynamo or magneto electric machine or electric engine, the combination, with the cylindrical armature-core, of the longitudinal inductive bars, two series of concentric rings, and commutator-connections, substantially as set forth.

This specification signed and witnessed this 25th day of June, 1881.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,

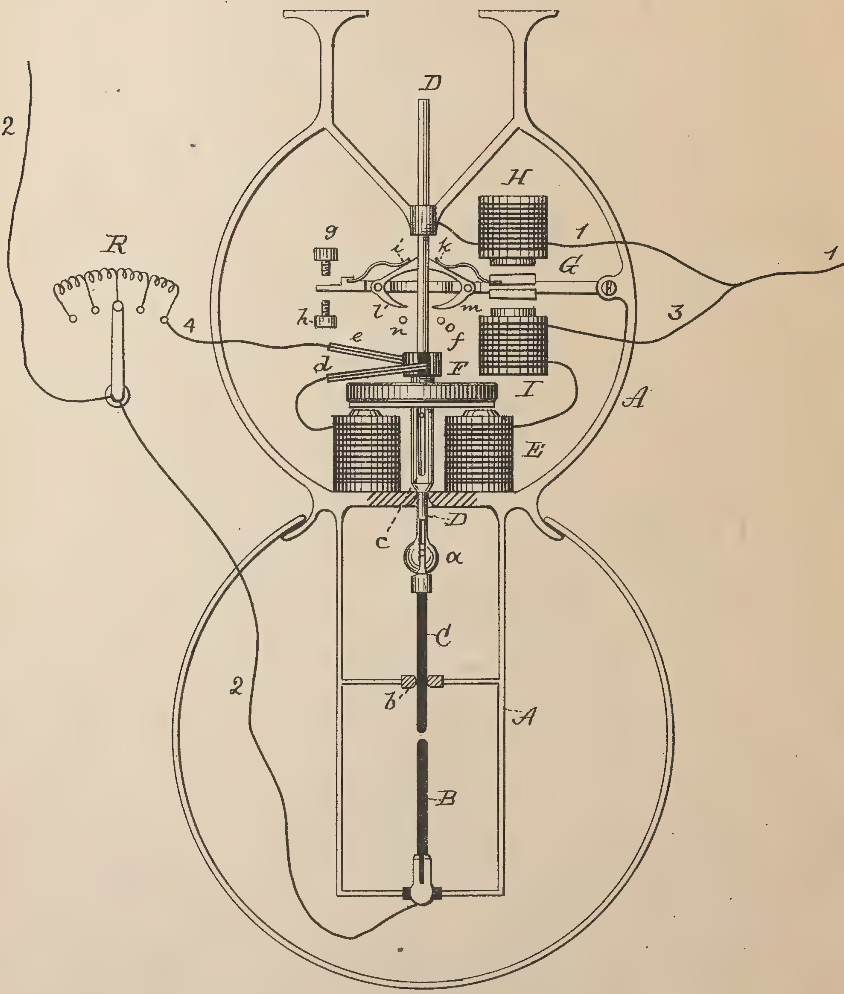
WM. H. MEADOWCROFT.

(No Model.)

T. A. EDISON.

ELECTRIC LIGHT.

No. 251,538. Patented Dec. 27, 1881.



Attest::

O. D. Mott

Rich'd N. Dyer.

Inventor::

T. A. Edison

per Dyer & Wilber,

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC LIGHT.

SPECIFICATION forming part of Letters Patent No. 251,538, dated December 27, 1881.

Application filed May 28, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric-Arc Lights; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

My invention relates to electric-arc lights using carbon pencils or rods, one or both of the carbons being fed forward lengthwise, and in which one (or both) of the carbons is given a rapid continuous rotation upon its longitudinal axis, the rapid rotation tending to cause the arc to remain perfectly steady at all times, (except, perhaps, for an instant occasionally when the feeding of the carbon or carbons takes place,) and the carbons will be consumed evenly.

I have found it necessary, in order to make an absolutely steady arc and secure an even and smooth consumption of the carbon points, to rotate one of the carbons at a high speed—as, for instance, from two to three thousand revolutions per minute; but a higher rate of speed could be used, and a lower speed might be found, under favorable conditions, to answer the purpose. It is evident that if both carbon pencils are rotated in opposite directions only half the speed for each would be required. For rotating one carbon I use an electro-motor of the Pacinotti or other suitable construction, arranged in the lamp-circuit or in a shunt or derived circuit therefrom, or otherwise suitably connected with the source of energy. If both carbons are rotated, connections may be made with one motor or driving mechanism; or a separate motor or driving mechanism can be used for rotating each carbon. If a feeding-carbon is rotated, the metal rod that carries it will be connected with a revolving part of the motor by a feather or other device, so that the metal rod can slide freely through the part of the motor that rotates it.

The revolving carbon pencil is preferably secured to its rod by a universal joint, (a ball-and-socket joint with locking-pin and slot answering well for this purpose,) and is guided near its point, so that any vibrating or wabbling movement of the metal rod will not change sensibly the position of the carbon point.

For feeding one or both carbons any mechanism can be used, so far as the main features of my invention are concerned. I prefer, however, to regulate the feed of the upper or positive carbon by means of an armature, through an opening in which the metal holding-rod passes. This armature carries two pawls that clamp the rod to hold it up, the armature being supported by an electro-magnet in the lamp-circuit. When, however, the resistance of the lamp-circuit is increased to a certain point by the lengthening of the arc, or when the arc is ruptured, a magnet in a shunt or multiple-arc circuit overcomes the first magnet and draws the armature downwardly. The clamping-pawls have arms, which strike stops when the armature reaches its lowest position and throw the pawls away from the holding-rod, allowing the carbon to drop. The magnet in the lamp-circuit again becomes the more powerful, and stops the further descent of the carbon or raises the armature and carbon to re-establish the arc when ruptured.

The preferred manner of carrying out this invention is shown in the accompanying drawing, in which the figure represents a side elevation and partial section of the lamp and regulating mechanism.

A is the frame, B the lower or negative carbon, and C the upper or positive carbon, connected with metal holding-rod D by ball-and-socket joint *a*, and guided near its point by guide *b*.

1 2 are the main conductors. E is the electro-magnet of the motor, the coils of which are in derived circuit 3 4, and are located on the frame A on opposite sides of the holding-rod D. The revolving armature F of the motor is supported by sleeve *c* from top of frame A, through which sleeve slides the rod D, the rod and sleeve being connected, so as to rotate together, by a feather or other suitable device. The commutator-springs of the motor are represented by *d e*, while *f* is the revolving circuit-breaker. An adjustable resistance, R, is placed in the motor-circuit 3 4, by means of which the speed of the motor can be regulated.

G is a horizontal armature-lever, pivoted on

the frame above the motor and playing in the fields of two electro-magnets, H I, the movement of the armature being limited by stops *g h*. The magnet H is in the lamp-circuit 1 2, while I is in motor-circuit 3 4. The rod D passes through an opening in lever G, such lever being provided with spring-pawls *i k*, that clamp downwardly on such rod. The pawls have arms *l m*, and stops *n o* are located at such points on the frame that the pawls are thrown upwardly away from rod D when the armature-lever reaches a certain point in its downward movement.

While the mechanism for independently and continuously rotating a carbon rod or pencil has been shown as connected to the carbon intended to be fed forward, it is evident that such mechanism may be applied to either or to both carbon rods or pencils.

What I claim is—

1. In an electric-arc light, the combination, with the carbon pencils or rods, of an electro-motor acting independently of the feeding mechanism and rotating continuously a carbon rod or pencil, substantially as set forth.

2. In an electric-arc light, the combination of an electro-motor acting independently of the feeding mechanism and rotating continuously a carbon rod or pencil, a carbon-holding rod sliding freely through a part revolved by the motor, but connected so as to turn with such part, and mechanism for controlling the longitudinal movement of such rod, substantially as set forth.

3. In an electric-arc light, the combination of the carbon-holding rod, two magnets, an armature-lever playing between the magnets, and two pawls provided with lever-arms, pivoted upon the lever, one on either side of the carbon-holding rod, and holding or releasing the carbon-holding rod as the armature is attracted by one or the other of the two magnets for governing the feed of the carbon, substantially as set forth.

4. In an electric-arc light, the combination, with the rod D, of the armature-lever G, controlled by magnets H I, and carrying pawls *i k*, having arms *l' m*, and the strips *n o*, substantially as set forth.

This specification signed and witnessed this 27th day of May, 1881.

THOS. A. EDISON.

Witnesses:
WM. H. MEADOWCROFT,
H. W. SEELY.

(No Model.)

T. A. EDISON.

ELECTRIC LAMP.

No. 251,539. Patented Dec. 27, 1881.

Fig. 4.

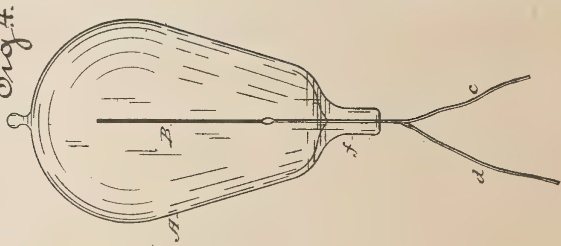


Fig. 3.

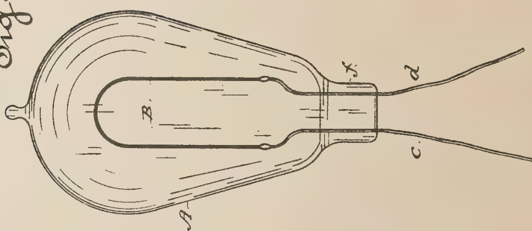


Fig. 2.

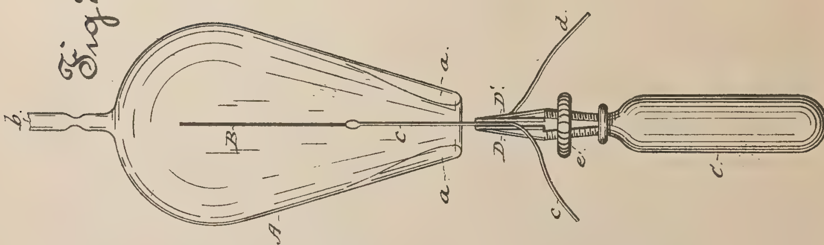
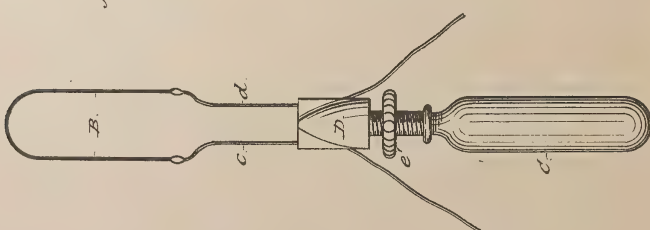


Fig. 1.



ATTEST:

S. D. Mott

John C Schroeder

INVENTOR:

T. A. Edison

per

Dyer & Wilber

Attys.

N. PETERS. Photo-Lithographer. Washington. D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 251,539, dated December 27, 1881.

Application filed May 27, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

It is desirable for some purposes or locations to provide a shorter lamp and one of simpler and cheaper construction than the incandescing lamp before produced by me. This I accomplish by sealing the leading-in wires which support the carbon directly in the lower end of the bulb, thus making the glass portion of the lamp in one piece instead of in two pieces fused together, as heretofore practiced by me. The glass bulb is blown from a tube, or directly from the pot or molten glass, in which operation the bulb is increased somewhat in thickness at its neck or lower end. The carbon is secured to the leading-in wires by means of clamps, plating, or soldering. The carbon is introduced into the lower end of the bulb, and the carbon and wires are held in the right position by means of a proper clamping-tool. The lower end of the bulb is then heated to the point of fusion, when it is compressed upon the wires, closing tightly such lower end and securing the wires therein. The bulb is then exhausted from its other end and sealed in the manner described in patents already granted to me and in former applications. By setting the bulb into a suitable socket and making the proper connections of the leading-in wires with the metal rings of the socket the lamp is completed ready for use.

In the drawings, Figure 1 is an elevation of the carbon and leading-in wires secured together, such wires being held by the clamping-tool which is used for introducing the carbon and wires into the bulb; Fig. 2, an elevation of the bulb, the carbon, the wires, and the clamping-tool, such carbon and wires being shown as introduced into the bulb previous to heating and compressing the same at its lower end; Fig. 3, an elevation of the lamp complete, with the exception of the socket; and Fig. 4, a similar view when the lamp is turned one-quarter way around.

Like letters denote corresponding parts in all four figures.

A is the glass bulb, which is somewhat shorter than those before made by me, and has the walls of its lower open end made thicker than the body of the bulb, as shown at *a*. The upper end of the bulb is provided, as in my other incandescing lamps of this character, with a small tube, *b*, through which the bulb is exhausted.

B is the incandescing carbon, made of any suitable material; and *c d* are the leading-in wires of the lamp. The carbon is secured to the leading-in wires by means of clamps or by plating or soldering. The carbon and wires are introduced into the bulb A and held properly therein by the clamping-tool, (shown in Figs. 1 and 2,) or by any other suitable device. This tool has a handle, C, and spring-jaws D D′, which spring apart normally, and are forced together by a milled nut, *e*, working on the screw-threaded shanks of such spring-jaws. The leading-in wires are grasped by this tool, and the carbon and wires held in the bulb thereby. The lower end of the bulb is then heated to the point of fusion and is compressed upon the wires, as shown at F in Figs. 3 and 4. The lamp is then exhausted and sealed, as will be well understood, and is ready to receive a proper socket. The bulb is compressed upon the leading-in wires for a sufficient distance at its lower end to form a good support for the wires, which in turn support the carbon.

What I claim is—

An incandescing electric lamp consisting of a glass bulb, A, formed originally with an open lower end having thickened walls, an incandescing conductor, and leading-in wires secured directly in the lower end of said bulb by the compression thereon of the thickened walls, substantially as shown.

This specification signed and witnessed this 17th day of May, 1881.

THOMAS A. EDISON.

Witnesses:

WM. H. MEADOWCROFT,
H. W. SEELY.

(No Model.)

T. A. EDISON.

CARBON FOR ELECTRIC LAMPS.

No. 251,540. Patented Dec. 27, 1881.

Fig. 1.

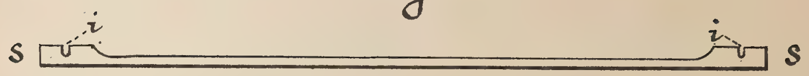
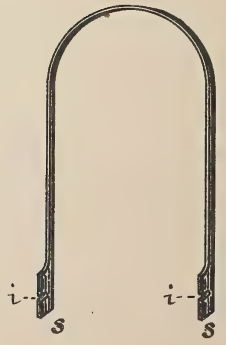


Fig. 2.



WITNESSES:

O. D. Mott

M. J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

CARBON FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 251,540, dated December 27, 1881.

Application filed August 6, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Carbons for Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In incandescent electric lighting I prefer to use for the incandescing conductor a small slip or filament of carbon bent into a curve, now generally designated the "horseshoe" carbon. Great success has attended the use of such carbons made from a naturally fibrous material capable of carbonization—for instance, wood formed into proper shape and then carbonized. I have found, however, that the best results are attained with the use of those materials which are fibrous, and wherein the fibers making up the mass of material lie naturally parallel, so that the individual fibers extend from end to end, increasing its strength and obviating danger of breakage from cross or oblique grain.

To produce the best results in giving light it is essential that the carbons should be of uniform size throughout the portion that is rendered incandescent, in order that radiating-surface and resistance be regular and uniform, insuring even heating and incandescence.

The object of this invention, therefore, is to produce a small slip or filament for the carbon having parallel fibers and of uniform size; and to this end it consists in a carbon made of the materials and in the way more particularly hereinafter described and claimed.

I have found that for the purposes of the carbon filament cane bamboo is eminently suited, it having long parallel fibers, and with a minimum of cementing or other foreign matters. The cane bamboo is cut into strips, from which the hard glossy or silicious exterior and the pithy interior have been before removed, or from which they are now removed. Each strip is then cut or shaved by proper devices or machinery until its body, or part intended for light-giving, is reduced to the desired form and size, the ends being formed into enlargements, affording a good bearing or surface for uniting the finished carbons to metallic conductors. It is preferable that these enlargements of the ends be formed entirely upon side of the finished slip which forms the blank for carbonization, instead of upon both sides. This construction enables the blank, when placed on edge in the carbonizer, to more readily move therein as it is contracted in the process of carbonization. As the material shrinks in the process of carbonization, the finished carbon being smaller than the blank, allowance is to be made therefor in preparing the blanks, and they should be made proportionately larger than the size desired for the finished carbon. One or a number of blanks thus prepared are then placed in a suitable carbonizing oven or flask and thoroughly carbonized.

In the drawings, Figure 1 represents a blank made from cane bamboo, ready for carbonization, having enlarged or clamping ends *s s* formed on one edge only, while in these enlarged or clamping ends are the slots *i i*, by which the slips may be secured in the carbonizer, and which also may form the holes through which pass the screws or clamps, if clamps be used for securing the finished carbon to leading-in wires. Fig. 2 shows in perspective a finished carbon made from the blank shown in Fig. 1.

What I claim is—

1. A slip or filament for forming on carbonization the incandescing conductor of an electric light, made of bamboo or similar fiber, substantially as set forth.

2. An incandescing carbon conductor for electric lights, made from cane bamboo or similar fiber, substantially as set forth.

This specification signed and witnessed this 28th day of July, 1880.

THOS. A. EDISON.

Witnesses:

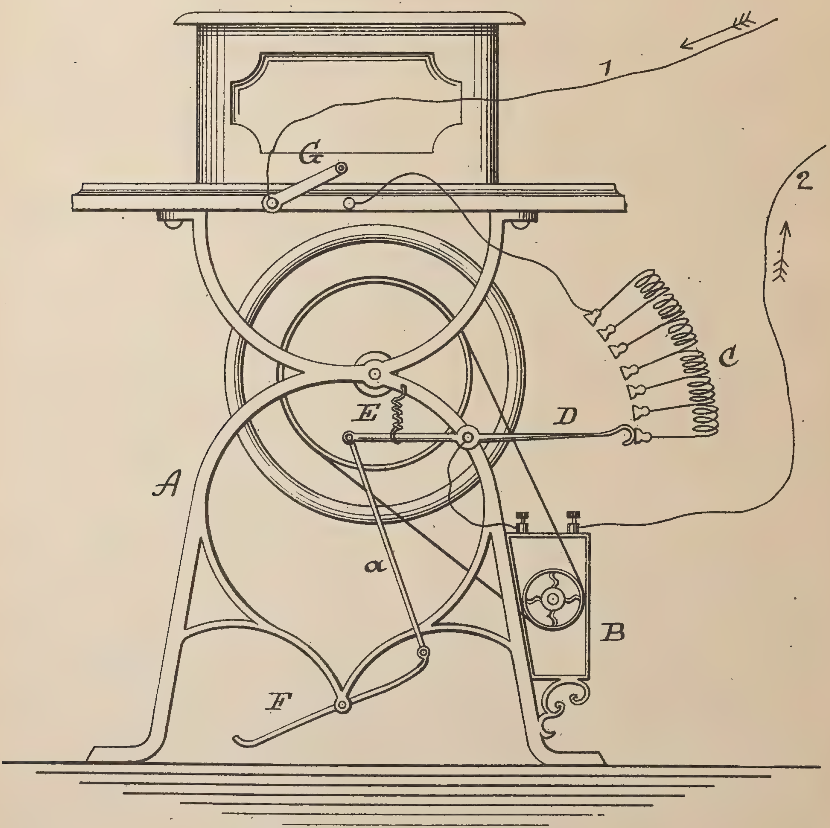
CHAS. BATCHELOR,
G. E. GOURAND.

(No Model.)

T. A. EDISON.

ELECTRO MAGNETIC MOTOR.

No. 251,541. Patented Dec. 27, 1881.



Attest:

O. D. Mott

M. J. Clagett

per

Inventor:

T. A. Edison

Dyer & Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRO-MAGNETIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 251,541, dated December 27, 1881.

Application filed May 31, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electro-Magnetic Motors; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object I have in view is an improvement in electro-magnetic motors for driving light machinery—such as sewing-machines, lathes, &c., but especially designed for sewing-machines—which improvement will enable the speed of the motor to be readily regulated, so that the driven machine can be run fast or slow, as desired, without breaking circuit, and so that in starting or stopping the motor the resistance of its circuit will be regulated in order to prevent any noticeable effect upon the electric lamps in the system, the motor and lamps being worked upon the same conductors. This I accomplish by including in the motor-circuit an adjustable resistance and a lever, operated preferably by a foot-treadle, such devices enabling the operator to throw resistance into and out of the circuit by the movement of the foot-treadle, and thereby to run the driven machine at a slower or faster speed. The lever is also adapted to stand normally so that upon closing circuit all the resistance will be thrown in, and the necessary degree of magnetization will be attained before any resistance will be thrown out, so that as the wire resistance is thrown out the motor will increase in speed and give a counter electromotive force in its own derived circuit and compensate for the lessening of actual wire resistance. In this way a nearly constant resistance will be maintained and lamps connected with the same main conductors will not be appreciably affected. A suitable switch conveniently located is provided for making and breaking circuit.

In the drawing a sewing-machine is represented in end elevation with my improvement attached thereto.

A is the frame of a sewing or other light machine, and B is the motor mounted thereon and driven by the circuit 1 2, derived from the main conductors of the system. C is the wire resistance, and D is a lever pivoted to the frame A, through which resistance and lever the circuit 1 2 passes. This lever is drawn in one direction, so as to throw all the resistance into the circuit by a spring, E, and it is connected by a rod, *a*, with a foot-treadle, F. G is the switch for making and breaking the circuit.

What I claim is—

1. The combination, with an electric motor, of a resistance, a lever included in the motor-circuit and adapted to be operated by hand or foot for throwing the resistance in or out of circuit, and means for normally holding the lever at the point to throw in the maximum resistance, substantially as described.

2. The combination, with the electric motor, of the resistance, the lever, the retracting-spring, the foot-treadle, and switch, substantially as set forth.

This specification signed and witnessed this 20th day of May, 1881.

THOMAS A. EDISON.

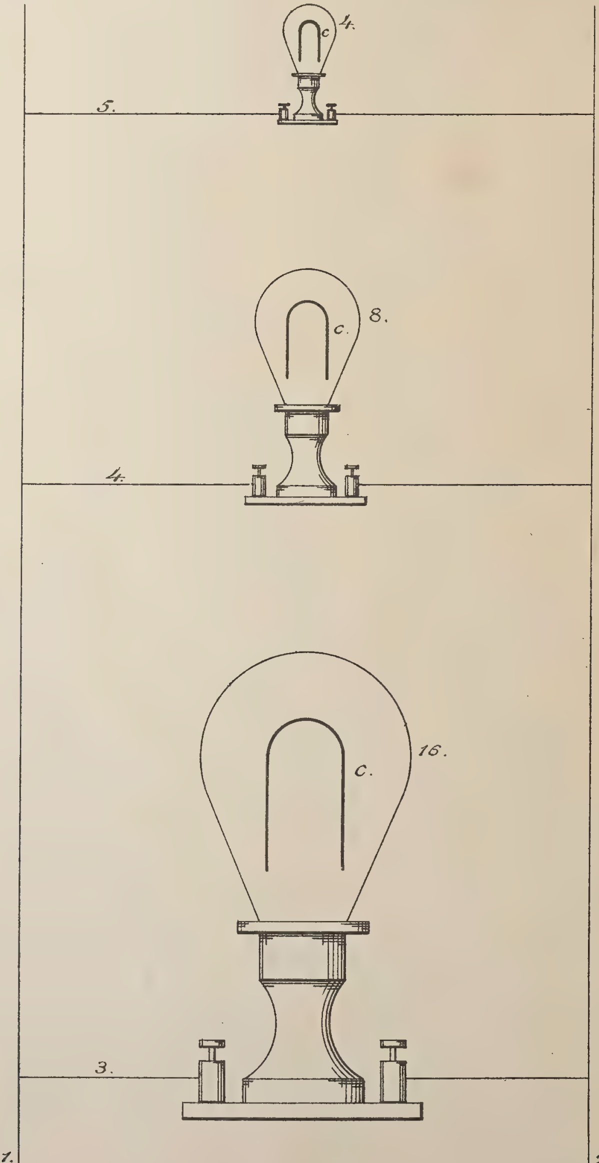
Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

SYSTEM OF ELECTRIC LIGHTING.

No. 251,542. Patented Dec. 27, 1881.



Attest;
F. W. Howard
J. E. Clark

Inventor;
T. A. Edison
Per Dyer and Wilber
Attys

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

SYSTEM OF ELECTRIC LIGHTING.

SPECIFICATION forming part of Letters Patent No. 251,542, dated December 27, 1881.

Application filed April 26, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electric Lighting; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In a system of electric lighting wherein very many lamps are to be supplied from one central station, as I have described in prior applications, it is essential that the electro-motive force or pressure throughout the system be maintained constant. In such systems the lamps are then so proportioned, as to radiating-surface and resistance, that all the lamps in a system shall give a standard amount of light. Under some conditions it seems desirable that provision should be made enabling lamps giving less than the standard amount of light to be used in a system with standard lamps without any additional devices—such as resistances, &c.—that is, supposing that a lamp giving, under the normal pressure of current in the system, sixteen candle power be taken as the standard, it may be desirable to use in the same system lamps giving four, six, eight, or twelve candle power.

The object of this invention is to furnish a method for attaining this object. This method may be briefly stated as consisting in diminishing the radiating-surface and increasing the resistance of the lamp in the ratio which the diminished lamp bears to the standard lamp.

In the drawing, suppose 1 2 to be main conductors, upon multiple arcs thereto, 3 4 5, the lamps 16 8 4 being placed. Suppose that the conditions are such that with the standard radiating-surface and resistance of the lamps and standard pressure of the system the lamp 16 gives sixteen candle power, then, if in 8 the radiating-surface be diminished one-half, while its resistance is doubled in comparison with the standard lamp, this lamp may be used in the same system with the standard lamp, but will give only eight candle power; or, to put it in figures, suppose the resistance of the standard lamp to be one hundred ohms and its radiating-surface ten millimeters, to use in the same system the lamp 8 its carbon *c* must have a resistance of two hundred ohms and a radiating-surface of five millimeters. Applying the same method, the lamp 4 may be made to give four candle power, and other lamps may be introduced giving any desired candle power.

In the drawing, for convenience of illustration, the lamps and their carbons are shown differing greatly in apparent size. They may be so constructed, but not necessarily so. The carbons may be of same length and the lamps apparently of the same size, the variations in size and resistance being made by changes in the other dimensions of the carbons; or all the dimensions of the carbons may be varied.

What I claim is—

1. The combination, with the main circuit of a system of incandescent electric lighting in which normally a standard amount of light is to be produced from lamps of a standard resistance and radiating-surface, a constant and uniform pressure of current being maintained, of lamps, such as described, giving less light than the standard of the system, and whose radiating-surface is diminished and resistance increased proportionately as the light-giving power is to fall below the standard, substantially as set forth.

2. The method of diminishing the light-giving capacity of an incandescent electric light below the standard of a system, electro-motive force or pressure therein remaining unchanged, consisting in diminishing the radiating-surface and increasing the resistance proportionately from the standard of the system as the light-giving capacity is to be diminished, substantially as set forth.

This specification signed and witnessed this 19th day of April, 1881.

THOS. A. EDISON.

Witnesses:

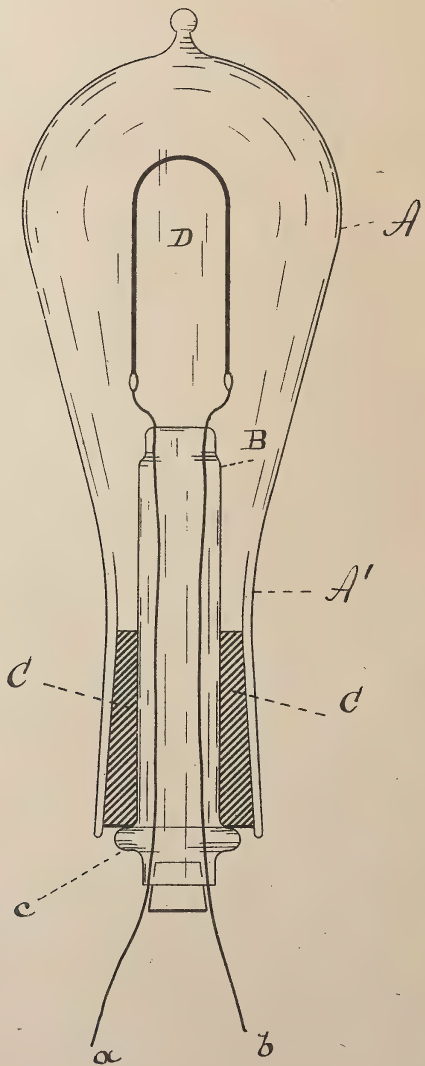
BERNARD J. KELLY,
SAMUEL INSULL.

(No Model.)

T. A. EDISON.

ELECTRIC LAMP.

No. 251,543. Patented Dec. 27, 1881.



WITNESSES:

O. D. Mott
M. J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 251,543, dated December 27, 1881.

Application filed August 30, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In Patent No. 239,372 is shown a lamp in which the glass wire-support is held in a tapering soft-rubber stopper forced in the neck of the globe. Now, it is my object to produce a simple lamp of this construction in which the wire-support cannot be forced by atmospheric pressure through the stopper into the globe, and the rubber stopper will be removed far enough from the light so that it will not be affected by heat conducted therefrom by the glass globe, and no mercury seal will be required to preserve an air-tight joint. A lamp of this construction is adapted to be taken apart when the carbon is destroyed, and all the parts except the carbon filament again utilized.

I construct the globe with a long neck, the lower end of which has a slight outward taper or flare. The glass wire-support is made tubular in form and of sufficient length to bring the carbon in the center of the globe. This tubular wire-support has its lower end enlarged or provided with a head or knob, which rests against the rubber stopper and prevents the forcing of the wire support into the globe by atmospheric pressure. The stopper is molded of pure, or nearly pure, rubber, in a polished mold, and has an exterior taper corresponding with that of the neck of the globe. The stopper has a central opening, in which the glass wire-support fits closely. The stopper carrying the wire-support is forced into the tapering neck, and the globe is then exhausted and sealed. The atmospheric pressure has a tendency to force the rubber stopper into the globe, and this pressure, on account of the taper of stopper and neck, serves to make the stopper close tight around the wire-support, and also to hug close to the surface of the globe-neck. At the same time the knob or enlargement prevents the wire-support being forced in too far, the length of the support being so proportioned that when the knob is forced against the base of the rubber stopper the carbon filament shall be in proper position within the globe. When the carbon is destroyed air is admitted to the lamp preferably by breaking off the sealing projection, and the stopper is then drawn out of the neck of the globe, carrying the wire-support with it. A new carbon filament is attached to the leading-in wires, the globe has a glass tube fused to its upper end over the perforation made by breaking off the sealing-projection, and the wire-support and stopper are again inserted in the globe, when the globe is exhausted and sealed. The neck of the globe is of such length that the heat conducted downwardly by the glass is mostly diffused into the air, and the glass in contact with the rubber is not heated sufficiently to affect the joint between the rubber and glass.

In the drawing the figure is a vertical section of an incandescing electric lamp constructed according to my present invention.

A is the glass globe, which is extended at A′ to form a long neck, the lower end of which has an outward taper or flare. B is the long tubular glass wire-support, provided with an enlargement or knob, *c*, on its lower end. C is the tapering rubber stopper. D is the carbon filament, and *a b* the leading-in wires.

What I claim is—

The combination of an inclosing-globe having a neck with outwardly-flaring sides, a perforated stopper with a correspondingly-shaped exterior, and a tubular wire-support provided at its lower end with a knob or enlargement, and fitting tightly within the perforation of the stopper, all adapted and arranged to maintain a tight joint and to determine the position of the carbon within the globe, substantially as set forth.

This specification signed and witnessed this 24th day of May, 1881.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

MANUFACTURE OF ELECTRIC LAMPS.

No. 251,544. Patented Dec. 27, 1881.

Fig. 1.

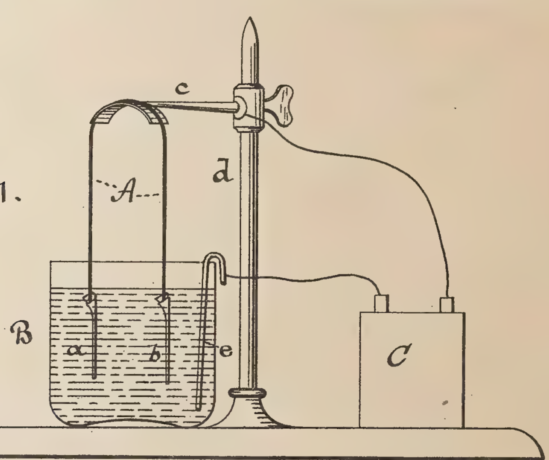
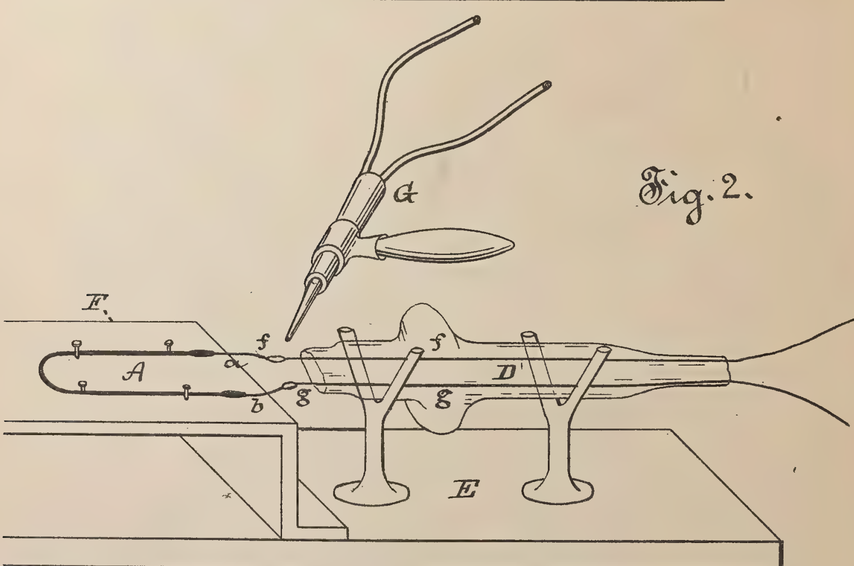


Fig. 2.



WITNESSES:

O. D. Mott

M. J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MANUFACTURE OF ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 251,544, dated December 27, 1881.

Application filed June 22, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce a simple and economical method of uniting the carbon filament of an incandescing electric lamp with the leading-in wires of the same. This I accomplish by first attaching short copper wires to the ends of the carbon filament mechanically, then uniting the wires and carbon filament permanently by electroplating the joints, and then fusing or soldering these short wires to the leading-in wires which have been previously sealed in the glass wire support of the lamp. The short copper wires may be connected directly with the platinum wires that are sealed in the glass, or with intermediate sections of copper wire.

For carrying out this method I use an electroplating-cell, into which the ends of the carbon and the short copper wires mechanically attached thereto are hung, the carbon loop being supported by a metal arm to which the negative pole of the battery is connected. This arm may be adjustable vertically, so that the carbon can be set the right depth in the solution. The wires below the joint may be covered with varnish, wax, or other substance, preventing deposition thereon. The leading-in wires sealed in the glass wire-support and these short copper wires are brought together in the flame of a blow-pipe and fused, the glass wire-support and the carbon filament being held by suitable supports. The glass wire-support is then connected with the globe or bulb and the same exhausted and sealed as described in my patents and former applications.

In the drawings, Figure 1 shows the arrangement for electroplating the mechanically-formed joints of the carbon filament and short copper wires, and Fig. 2 the arrangement for fusing the wire ends together.

A is the carbon filament, which has the short copper wires *a b* secured to its ends mechanically. This may be accomplished in several ways; but I prefer to flatten the ends of the wires and wrap them around the carbon ends.

B is the electroplating cell, above which is the arm *c*, vertically adjustable on standard *d*. The carbon is hung over this arm into the solution of the cell, the negative pole of the battery C being connected with this arm, while the positive pole leads to the electrode *e*, forming the anode of the cell.

D is the glass wire-support of the lamp, and *f g* are the leading-in wires. The platinum sections of these leading-in wires are sealed in the top of the glass support.

E is a stand for holding the wire-support D in a horizontal position, and F is another stand for supporting the carbon filament, so that the short copper wires *a b*, united with said carbon filament by electroplated joints, can be brought together with the leading in wires *f g* in the flame of the blow-pipe G.

What I claim is—

The method of uniting the carbon filament and leading-in wires of an incandescing electric lamp, consisting in first attaching short wires mechanically to the carbon filament, then electroplating such joints, and then fusing or soldering these short wires to the leading-in wires of the lamp, substantially as set forth.

This specification signed and witnessed this 20th day of May, 1881.

THOS. A. EDISON.

Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

ELECTRIC METER.

No. 251,545. Patented Dec. 27, 1881.

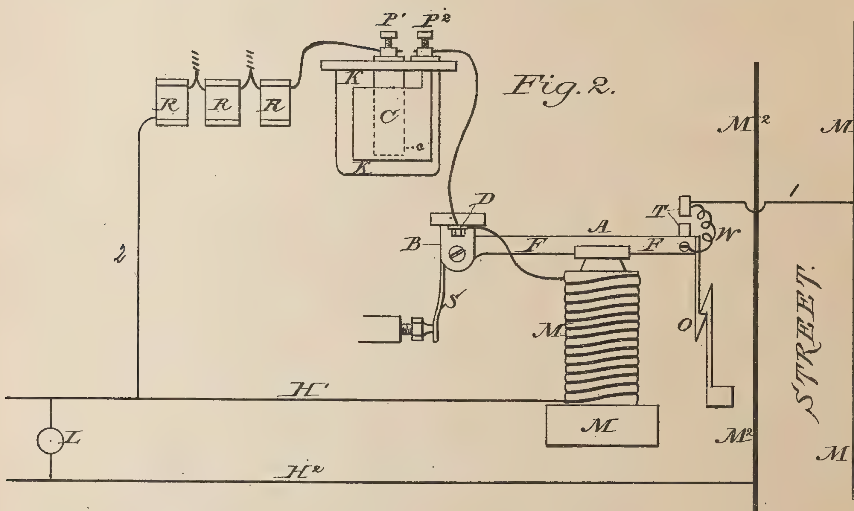


Fig. 2.

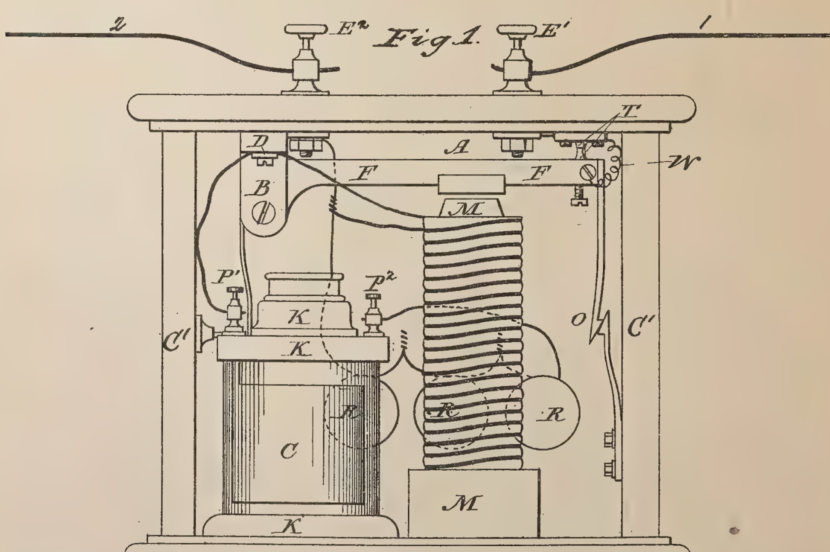


Fig. 1.

Witnesses:
F. W. Howard
J. H. Hall

Inventor:
T. A. Edison
per Dyer & Wilber
Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 251,545, dated December 27, 1881.

Application filed March 20, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Meters; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

Hitherto the meters proposed in systems for distributing electricity to consumers have been registers of time only, being adapted to simply preserve a record of the time during which a current was flowing through one or several translating devices without regard to the amount used. Such do not afford as equitable a basis for charges as one which would record or register or indicate the amount of current used irrespective of the time.

My invention therefore relates to a meter which shall afford data for accurately determining the amount of current used. I make use of the known fact that a certain unit of current will cause the deposition of a definite amount of copper from a proper solution. The circuit passing to the translating devices of any given locality finds in the meter-box there stationed two paths, one, which is the main circuit, through apparatus to be hereinafter explained to the translating device, the other, which is a shunt-circuit, through an electrolytic cell to the translating devices. The resistance of this latter path is made exceedingly large compared with that of the first—for illustration, say as one hundred to one. At the commencement of some fixed period an exactly-weighed strip of copper is placed in the cell, which is filled with a proper copper solution. At the end of the period it is weighed, the difference being the amount deposited. This amount is due to the action of a hundredth part of the current used, and the actual amount used can be calculated with great ease. The relation existing between current and cubic feet of gas can be ascertained by allowing the current to flow through an electric light of a definite photometric power—say sixteen candles—for a few hours, noting the deposition of copper in the cell for same time. During the same period a gas-flame of equal photometric power is burned and the number of cubic feet consumed noted. From the data thus obtained the resistance in the circuit of the cell may be so adjusted that the deposition of one milligram shall represent a current equal in light-giving capacity to one cubic foot of gas, and bills may be rendered in cubic feet.

Within the meter-box I arrange an electro-magnet in the circuit to the translating devices. This circuit passes through the back-contact point on the armature of the magnet, through the armature and the magnet, to the translating devices. The armature is held to its back-contact by a spring whose resilience is so adjusted that it may not be overcome upon the passage of ordinary currents through the coil of the magnet. When, however, a greater amount of current than usual is diverted through this circuit, owing to accidental short-circuiting, or any other cause, the armature is attracted and the circuit is broken. The armature is provided with a spring-latch, which locks it in position when once attracted and prevents the circuit being reopened. In order to prevent a spark upon the separation of the contacts, they are connected by a bit of very fine wire, which preserves the circuit for a moment after the contacts separate, when it is fused by the excess of current therethrough.

In the drawings accompanying and forming part of this specification, and showing a meter embodying my invention, Figure 1 is a view of the meter and adjuncts, and Fig. 2 shows more clearly the circuits.

M′ M² are the main conductors, from which proceeds and returns a circuit in which are the translating devices, whose consumption of current is to be measured, while in a shunt to such circuit is included the meter. These circuits are as follows: A conductor, 1, leads from M′ to the binding-post E², which is electrically connected to the contact-points T, one of which is carried by the armature F of the magnet M, whose armature-lever A is pivoted at B and is in the circuit. At D this circuit branches, one or the main branch passing around the magnet M and thence by H′ to the translating devices, (here typified by a lamp, L,) and thence by H² to M². The other is the branch or shunt circuit through the electroplating or

depositing cell C and resistances R R R. These latter are adjustable, in order that desired definite proportions of the total current may be sent through each branch. The spring S of magnet M is so adjusted that the force exerted upon F upon the passage of ordinary currents through F shall not serve to attract it. When, however, the current through M becomes unduly strong M attracts F, breaking circuit at contact T. Upon such attraction the latches O catch and lock the armature, so as to prevent the circuit again closing at T until the cause of the disturbance may have been investigated. A very small wire, W, connects the contacts T, preventing a spark upon their separation, and keeping up a circuit around M sufficiently long for O to securely lock, when W burns away, leaving the meter and translating devices entirely disconnected from the mains.

c is the copper plate in the cell K, whose difference in weight, due to deposition, affords the current measurement.

In Fig. 2, for clearness, the meter and attachments are shown as not inclosed in a box or case, the wires 1 2, connecting the meter to M' and H', being shown as connected directly to T and R, while the electrolytic cell is connected in the circuit by means of suitable binding posts, P' P^2. In practice, however, it is preferable to inclose the apparatus in a tight box or case, C', the wires 1 2 leading to binding-screws E' E^2 thereon, whence proper connections are made through the devices.

Having thus described my invention, what I claim is—

1. The combination of a main circuit, a shunt-circuit thereto containing an electrolytic cell and suitable resistances, a definite determinate fraction of the current passing through the main circuit being thereby diverted through the shunt-circuit and electrolytic cell, whereby data primarily for the measurement of the fraction shunted and ultimately for the measurement of the current passing through the main circuit are afforded, substantially as set forth.

2. The combination of a magnet, its armature and armature-lever and contact-points, one of the latter being upon the armature-lever, all arranged in an electric circuit, and a fusible wire connected to form a shunt around the contact-points, substantially as set forth.

3. The combination of a magnet and its armature, the latter and its back-stop forming normally part of the circuit to the magnet, a fusible circuit device maintaining c rcuit therethrough after the armature has been withdrawn from its back-stop, and a latch locking thereupon the armature against reclosure on its back-stop, the fusible circuit device itself being thereafter ruptured by the flow of current therethrough, substantially as set forth.

This specification signed and witnessed this 10th day of March, 1880.

THOS. A. EDISON.

Witnesses:

WM. CARMAN,

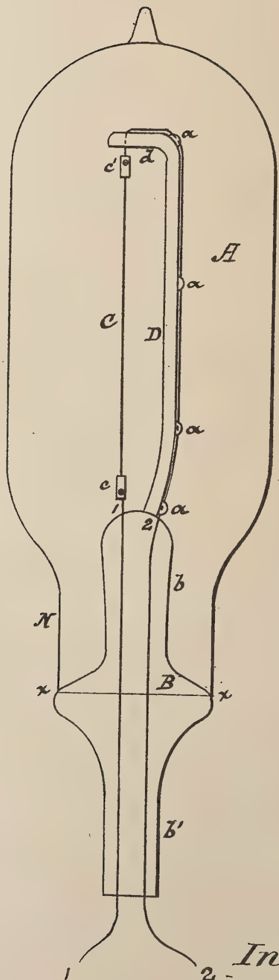
C. S. MOTT.

(No Model.)

T. A. EDISON.

ELECTRIC LAMP.

No. 251,546. Patented Dec. 27, 1881.



Witnesses:

S. D. Mott

James A. Payne

Inventor.

T. A. Edison

by Dyer & Wilber

Attorneys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 251,546, dated December 27, 1881.

Application filed August 17, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

As is well known, the lamp devised by me and used in my system consists of a strip or filament of incandescing material of high resistance bent into a loop, now commonly known as the "horseshoe carbon," hermetically sealed within a glass inclosing-globe.

It is well known that carbon expands by heating, especially with the very high heat necessary to its incandescence. This proved in the past a serious difficulty to the successful use of carbons in lamps, as the carbons then known were inflexible, and consequently after short use either the carbons were fractured or else the connection between the carbons and the conductors thereto were destroyed by the expansion. The carbons of my invention, however, in addition to possessing all the other qualities needed, possess the quality of flexibility, the carbons made by the processes before made known by me being exceedingly flexible as well as of high resistance.

It is sometimes desirable to construct a lamp in which the light-giving portion is in a straight line in order to give a line of light, instead of giving a circular or elliptical line of light.

The object of this invention is to make such a lamp, which may be done by using the high-resistance flexible carbon referred to in the manner more particularly hereinafter described and claimed.

In the drawing the one figure illustrates a lamp embodying the invention.

A is the inclosing-globe, of glass, preferably cylindrical in shape, with a dome-shaped top, the lower end being drawn into a neck, N.

A carbon-support, B, is made with its lower end fashioned into a supporting-neck, b', and the upper part into a bulb, b. These parts are united at the line $x\ x$.

Upon the bulb b is secured a glass arm, D, rising to a little greater height above b than the length designed to be given to the carbon to be used, the arm D then turning at about a right angle, as shown at d. A conductor, 2, is secured to the arm D either by being fused therein through its length, or at intervals, $a\ a\ a$, or by being bound thereto, or in any other convenient manner. The conductor 2 has at its inner end a clamp, c', in which is secured one end of the straight flexible carbon filament, C, whose lower end is in clamp c upon the inner end of conductor 1. Conductors 1 2 pass through and are sealed into b.

In the manufacture of the lamp the supporting-arm, the conductor, and the carbon are first placed in position upon b, B and A being then united and A exhausted, in the manner more fully described in United States Patent No. 230,255, granted to me. This construction furnishes a lamp in which the incandescent material is in a line giving a straight line of light, the arm D supporting the upper end at a proper height. The carbon, being flexible, bows slightly upon expansion under the influence of heat, avoiding the danger of fracture of the carbon or the destruction of its union with the conductors, which has beset former attempts in this line.

What I claim is—

The combination, with the carbon-supporting bulb, of a glass arm rising above the bulb and supporting one end of a straight carbon and the conductor leading thereto, substantially as set forth.

This specification signed and witnessed this 10th day of August, 1880.

THOS. A. EDISON.

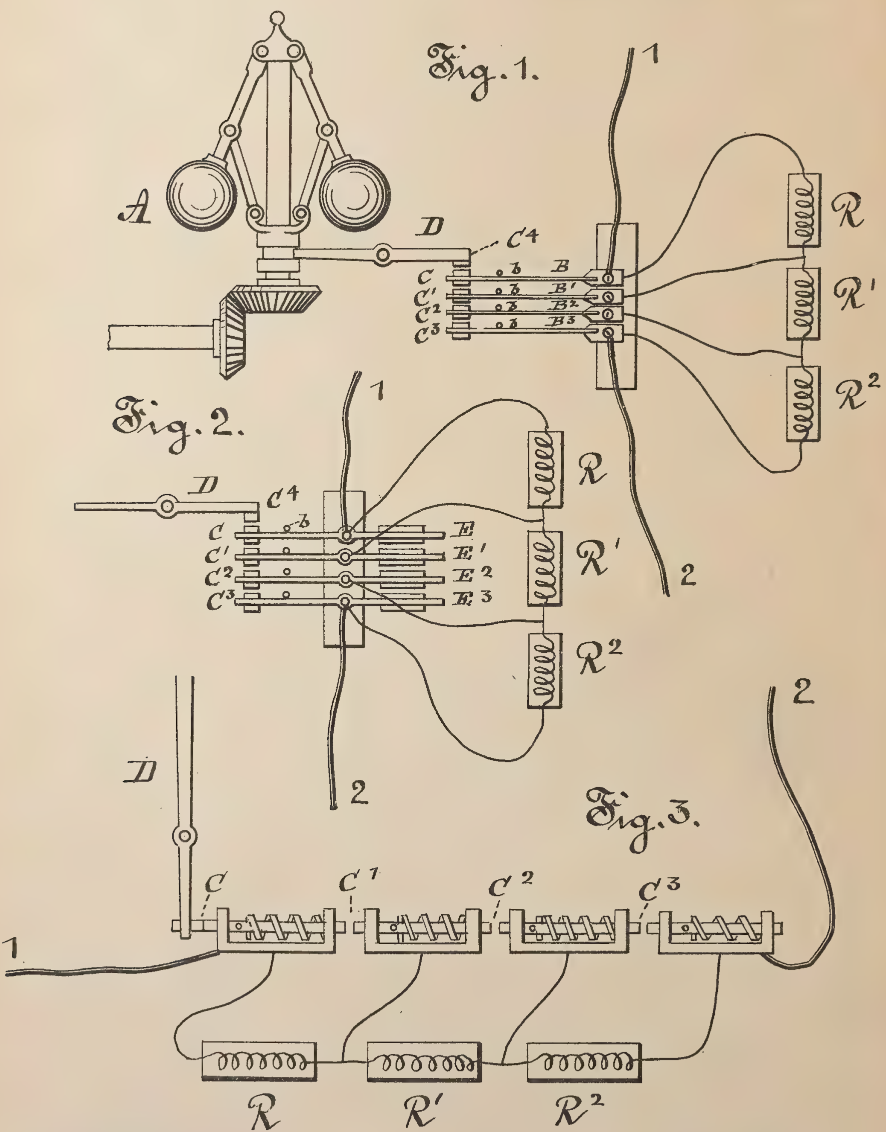
Witnesses:
WM. CARMAN,
OTTO A. MOSES.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

ELECTRICAL GOVERNOR.

No. 251,547. Patented Dec. 27, 1881.



WITNESSES:

O. D. Mott.
J. E. Clark.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

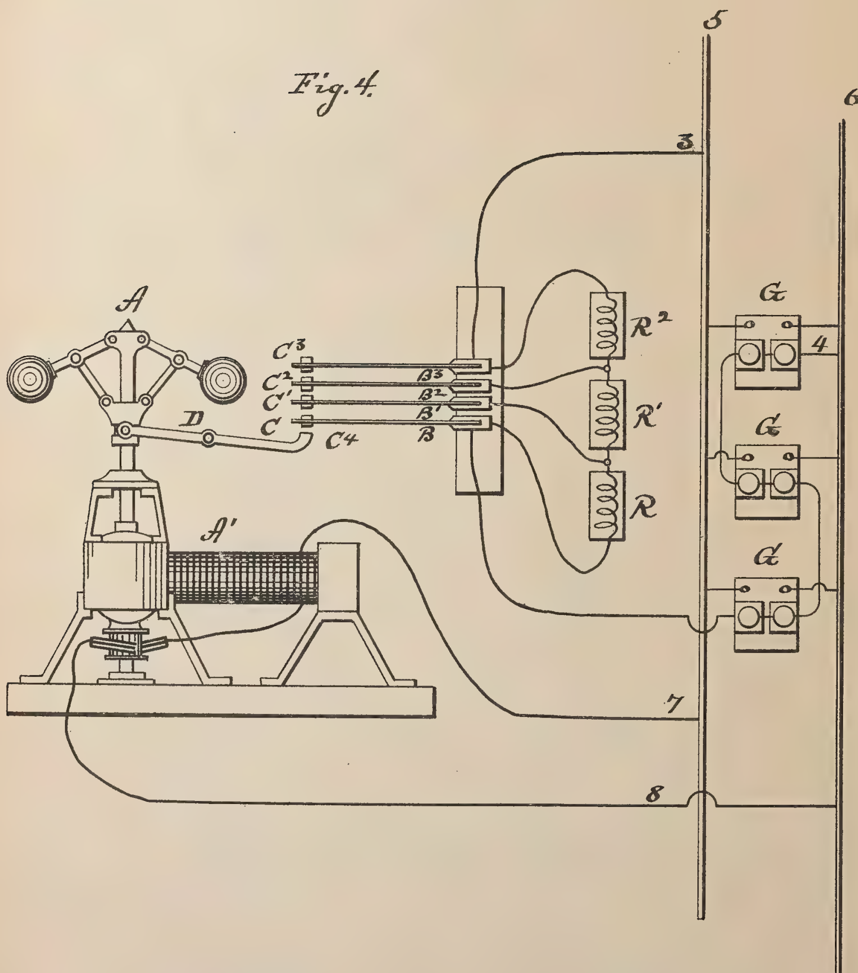
N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

ELECTRICAL GOVERNOR.

No. 251,547. Patented Dec. 27, 1881.



WITNESSES:

D. D. Mott

John C Schroeder

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRICAL GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 251,547, dated December 27, 1881.

Application filed June 24, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Governors; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In a system of electrical distribution in which both lamps and motors are placed in circuits derived from the same main or consumption circuit the throwing into circuit of a motor would momentarily affect the lamps if provision were not made to avoid this consequence, since the motor, before it attains its maximum speed and establishes a counter electro-motive force in its own derived circuit, has much less resistance and requires many times more current than a lamp. In my application No. 27,371, filed March 3, 1881, I overcame this difficulty by means of resistances in the derived circuit of the motor, which resistances are gradually thrown out of circuit as the speed of the motor increases by means of a lever moved by a centrifugal governor run by the motor, said lever making a sliding contact with the contact-plates of the resistances.

The object of my present invention is to produce means for making and breaking the contact of the governor-lever and resistance contact-plates which will do away with the friction of a sliding contact and permit of the throwing in and out of all the resistances by a short movement, making the governor much more sensitive in its action. This I accomplish by connecting the resistances with movable contact blocks or plates, located in line with each other and forced together in succession by the movement of the governor, and returned to their normal positions by springs or by gravity. The governor for this purpose works a pivoted lever having on its free end a contact block or plate in line with the contact of the resistances. The contact blocks or plates of the resistances can be arranged in a number of different ways. They can be carried by parallel spring-arms secured rigidly at one end, or by pivoted levers thrown in one direction by springs or by gravity, or they may be in the form of sliding pins forced in one direction by springs or by their own or additional weight; or other constructions could be devised for accomplishing the same end. When the motor is out of circuit the contacts will be separated and all the resistances will be connected with the line. The motor being thrown into circuit, the resistances in the derived motor-circuit will be sufficient to prevent any effect upon the lamps of the system, and as the speed of the motor increases the governor-lever will force the contacts together one after another, cutting out the resistances in succession as the counter electromotive force established by the speed of the motor increases until the maximum speed is reached, when all the resistances will be cut out or one or more may be allowed to remain to give the proper resistance to the motor-circuit. When the motor-circuit is broken the stopping of the motor and governor will allow the contacts to separate, so that the resistances will be in the circuit when the same is again completed. By reversing the arrangement the device could be used to control the field-circuit of a generator or battery of generators, the motor being driven by a circuit derived from the main circuit, and the governor throwing resistance into the field-circuit when its speed exceeds the normal rate.

In the drawings, Figure 1 is a top view of the governor and movable contacts, such contacts being carried by spring-arms; Fig. 2, a view showing the contacts carried by pivoted levers; Fig. 3, a view showing the contacts in the form of spring-pins, and Fig. 4 a diagrammatic view, showing the device arranged for regulating the resistance of the field-circuit of a battery of generators.

Like letters denote corresponding parts in all four figures.

A is a centrifugal governor, either horizontal or vertical, which is driven by an electro-motor, A′. (Shown in Fig. 4.)

R R′ R² are resistances in the derived motor-circuit 1 2, Figs. 1, 2, and 3. These resistances can be of any desired number. They are connected with movable contact blocks, plates, or points C C′ C² C³, which are placed in line with each other and held normally a short distance

apart. The pivoted governor-lever D has a contact, C^4, placed in line with the resistance-contacts, and adapted, when moved by the governor, to force the resistance-contacts together in succession or allow them to separate in succession and assume their normal positions. These contacts C C' C^2 C^3 may be carried by parallel spring-arms B B' B^3 B^3, as shown in Figs. 1 and 4, or by pivoted levers E E' E^2 E^3, Fig. 2, which levers are moved in one direction by springs or by gravity. Stops *b* are used to limit the movement of the pivoted levers in one direction, and may also be employed in connection with the spring-arms. The resistance-contacts could also be made in the shape of pins, Fig. 3, which could be returned to their normal positions by springs or by their own or additional weight.

I do not limit myself to the means shown for carrying the movable contacts, since other means could be employed for the same purpose.

The device is shown in Fig. 4 arranged for regulating the generative force of a battery of Faradic generators by controlling the resistance of the field or exciting circuit. The governor is shown as running at a speed higher than the normal rate, all the resistance being thrown into the field-circuit 3 4 of the generators G. The main or consumption circuit is shown at 5 6, while the derived circuit, in which the governor-motor A' is placed, is shown at 7 8. As the electro-motive force of the current decreases the speed of the motor A' and governor A will lessen, and the contacts C' C^2, &c., will be made in succession by the governor-lever D, so as to cut out the resistances.

What I claim is—

1. The resistances having movable contacts located in line with each other, in combination with means for making and breaking the contacts in succession, substantially in the manner set forth.

2. The resistances having movable contacts located in line with each other, in combination with a governor driven by an electro-motor and adapted to force the contacts together in succession, and means for breaking the contacts in succession as the force of the governor is removed, substantially as set forth.

3. A centrifugal governor driven by an electro-motor and a lever, in combination with a plurality of resistances and movable contacts, said contacts being forced together in succession by the governor-lever and returned to their normal positions by springs or by gravity, substantially as set forth.

This specification signed and witnessed this 2d day of June, 1881.

THOS. A. EDISON.

Witnesses:

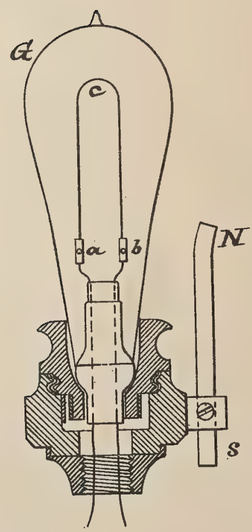
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 251,548. Patented Dec. 27, 1881.



Attest.
Chas Raettig.
O. D. Mott

Inventor.
T. A. Edison.
pr Dyer & Wilber
Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 251,548, dated December 27, 1881.

Application filed January 31, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Incandescent Electric Lamp; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of this invention is to provide an incandescent electric lamp consisting of a carbon filament hermetically sealed in an exhausted glass containing-chamber, with means whereby the carbon particles thrown off by the carbon filament may be attracted downwardly, in order that the formation of an arc between the limbs of the carbon, and also whereby the blackening of the inclosing glass chamber above the base of the carbon by the deposition thereon of the carbon particles referred to, may be avoided. This I accomplish by combining with each lamp a magnet arranged relatively to the carbon filament, so that it will attract the highly electrified carbon vapor within the glass containing-chamber downwardly. An illustration of this is given in the drawing, which is a view of a lamp with a magnet attached, in which—

G is a lamp consisting of a hermetically-sealed exhausted glass globe, within which the carbon filament *c* is secured in clamps *a b*. Upon the side of the lamp, and in suitable supports, is fixed the magnet N S, whose upper end reaches preferably to about the height of the clamps.

If the magnet be placed, as shown, with its N pole uppermost, it is to be arranged upon the positive side of the lamp; if with the S pole uppermost, then upon the negative side of the lamp.

It is evident that variations may be made. For instance, an electro-magnet may be used instead of the permanent magnet; or a two-limbed magnet may be used, its poles being properly disposed in relation to the positive and negative sides of the carbon filament; or the single or double limbed magnet may be placed within the glass inclosing-globe; or, instead of a regular magnet, a coil of wire through which a current is passed may be used.

The magnet or current used may be a very weak one, as such will suffice to deflect electrified carbon vapor.

What I claim is—

1. The combination, with an incandescent electric lamp, of a magnet for preventing the deposition of carbon upon the upper part of the glass inclosing-globe, substantially as set forth.

2. The combination, with an incandescent electric lamp, of a magnet for attracting downwardly, or to the base of the lamp, the electrified carbon vapor formed therein, substantially as described.

This specification signed and witnessed this 19th day of January, 1881.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

ERNEST J. BERGGREN.

(No Model.)

T. A. EDISON.

ELECTRIC LAMP AND THE MANUFACTURE THEREOF.

No. 251,549. Patented Dec. 27, 1881.

Fig. 1.

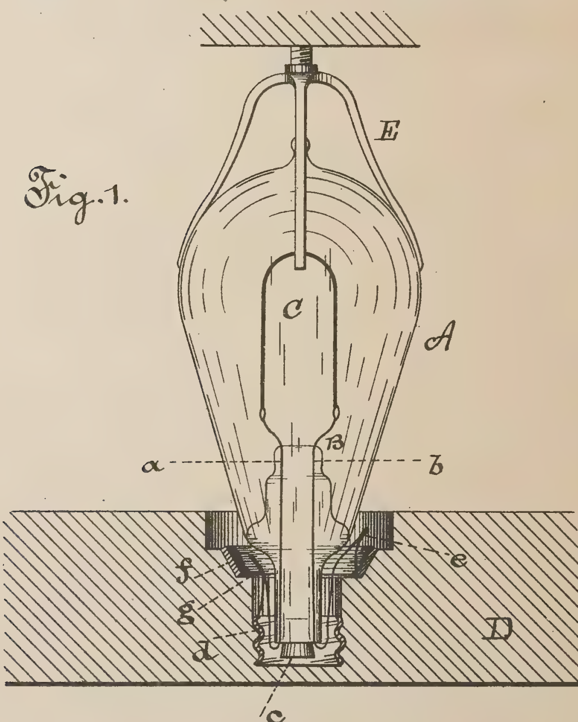
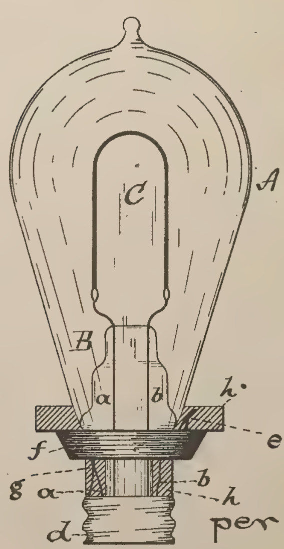


Fig. 2.



Attest:

O. D. Mott

H. W. Seely

Inventor:

T. A. Edison

per Dyer & Wilber

Attys

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC LAMP AND THE MANUFACTURE THEREOF.

SPECIFICATION forming part of Letters Patent No. 251,549, dated December 27, 1881.

Application filed May 31, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps and the Manufacture thereof; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

When it is intended that an incandescing electric lamp shall be readily removable from its socket or support it is necessary that the lamp be provided with a base, in or upon which are secured contact-plates, to which are electrically connected the wires leading to the incandescing conductor. Such base hitherto has been made of metal or wood, and the lamp then secured thereto or therein by cement.

The object of this invention is to provide a simpler and cheaper method of providing the lamp with the necessary base. This I accomplish by molding the entire base directly upon the neck of the lamp out of any suitable plastic material, the exterior contact-plates of the base necessary for completing the circuit from the socket to the incandescing conductor being secured properly to the base in the operation of molding it. In carrying this into practice metal rings, forming the exterior contact-plates of the base, are placed in a suitable mold, wires being first soldered to the inner surfaces of such rings, which are arranged to project upwardly on opposite sides of the mold. The wires of the lamp are bent up on opposite sides of the neck of the same, and the lamp is dropped into the center of the mold and held upright therein by a spring-holder which is adjusted down upon the same. The wire ends of the lamp and contact-rings are twisted together and turned down into the mold, when such mold is filled with plaster-of-paris, which is allowed to harden. The lamp is then removed from the mold; and the plaster of-paris may be colored to improve the appearance of the base, or the material may be colored prior to molding.

In the drawings, Figure 1 is a vertical section of the mold, showing the contact-rings therein and the lamp in position, with the wire ends twisted together; and Fig. 2, an elevation of the lamp complete, the lower end of the same being in partial section.

Like letters denote corresponding parts in both figures.

A is the globe or bulb of the lamp; B, the wire-support; C, the carbon filament, and *a b* the leading-in wires. These are constructed and the bulb is exhausted and sealed as fully described in my patents and former applications. A cork, *c*, is forced into the lower tubular end of the wire-support B to separate the wires *a b*, after which said wires are bent up on opposite sides of the neck, as shown in Fig. 1.

D is the mold, which is of the proper shape to produce the base. The metal screw-ring *d*, provided with wire *g*, fits the lower portion of such mold, while the plain beveled ring *f*, carrying wire *e*, is supported above the screw-ring by a beveled seat in the mold.

E is the spring-holder, which is adjustable vertically, and after the lamp is set into the mold is dropped upon the same and fixed in position so as to hold the lamp steady. The ends of the wires *a g* and *b e* are now twisted together and turned down into the mold, so as to be entirely covered by the plaster of-paris. The plaster-of-paris *h*, Fig. 2, is then poured into the mold and forms the body of the base, the metal rings surrounding the plaster-of-paris body. After the plaster-of-paris has hardened the spring-holder E is raised and the lamp is removed from the mold, when the plaster-of-paris may be colored, if desired; or the material may be colored prior to molding.

It is evident that these molds and spring-holders can be multiplied to any desired extent and arranged in series side by side.

While the base has herein been described as made of plaster-of-paris, it has been so done as a convenient illustration only, it being evident that any plastic material may be used—that is, any material which can first be put into condition for molding and which thereafter will harden or solidify, retaining the form given it by molding.

It is also evident, while rings encircling the base are herein shown as the contacts upon the base, that contacts of other form or shape may

be used thereon, as the invention in this case in no way relates to or is dependent upon the form, size, or shape of such contacts.

I do not claim herein a lamp provided with a base entirely of insulating plastic material molded directly upon its neck, as such subject-matter will form the subject of a separate application for a patent.

What I claim is—

1. The method of making the bases for and attaching the same to incandescing electric lamps, and attaching the exterior contacts to the base, consisting in placing the lamp and contacts connected to the respective terminals of the incandescent conductor in a mold and then filling the mold with plastic material around the neck of the lamp and within the contacts, whereby the entire base is formed of such plastic material, substantially as set forth.

2. The mold having seats for the contact-rings, in combination with a holder for retaining the lamp in its proper position in the mold, substantially as and for the purpose set forth.

This specification signed and witnessed this 20th day of May, 1881.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,

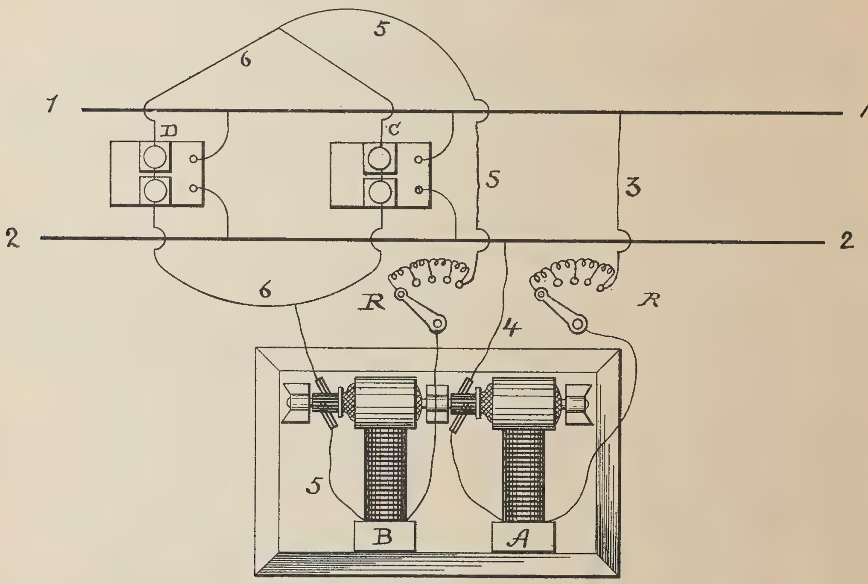
H. W. SEELY.

(No Model.)

T. A. EDISON.

MAGNETO OR DYNAMO ELECTRIC MACHINE.

No. 251,550. Patented Dec. 27, 1881.



Attest:

Sam D. Mott

Chas. T. Hughes

Inventor:

Thos. A. Edison.

Dyer & Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MAGNETO OR DYNAMO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 251,550, dated December 27, 1881.

Application filed March 3, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Faradic or Magneto or Dynamo Electric Machines; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of this invention is to furnish an arrangement of means whereby the field-of-force magnets of a number of Faradic machines may be readily and controllably energized. To this end, in a derived circuit from the main or consumption circuit of the Faradic machines or generators, is placed an electro-motor, which gives motion to a generator whose circuit is, by multiple arc, through all the field-of-force circuits of the generators. In the circuit of the motor is an adjustable resistance, so that its action may be varied, which, in turn, controls the generative capacity of the Faradic machines. In the circuit leading around the field-of-force coils is an adjustable resistance, so that that circuit may be controlled independently, if desired, of the motor-circuit, but with the same ultimate result. This is illustrated in the drawing, in which D C are the Faradic machines or generators, with their bobbins connected in multiple arc to the main or supply or consumption circuit 1 2. These generators D C are driven by any suitable motive power, and in a manner well understood in the art.

In a derived circuit, 3 4, is the motor A, which gives motion to the generator B. In this circuit 3 4 is an adjustable resistance, *r*, so that the amount of current energizing A may be controlled. The motor A gives motion to the Faradic machine or generator B, whose circuit 5 leads by multiple arcs 6 around the field-of-force magnets of C D, energizing them. In this circuit is an adjustable resistance, R, so that, other things remaining equal, the force of the current around the field of C D, and consequently the generative capacity of those machines, may be readily controlled.

Upon the first using of D C as generators their field-of-force coils are connected to any suitable source of energy—for instance, a galvanic battery or to a dynamo or magneto machine, the current from either serving to magnetize their cores. After this first magnetization the cores retain enough residual magnetism to start at least a weak initial current, which excites A, causing B to become active, its current passing through the field-circuit of D C and strengthening it, causing an increased current through 1 and 2 and through A, the increased current in the latter reacting upon the generators themselves, this sequence continuing until the maximum magnetization is attained.

By *r* A may be so controlled that its speed is varied to cause B to generate current enough only for the magnetization of the field to the degree necessary for the production of current requisite for the demands of the circuit 1 2; or the circuit 3 4 may be left constant and the current through the field-circuit controlled by R to affect and regulate the generative capacity of C D.

What I claim is—

1. The combination, with a battery of Faradic machines, of an electric motor in a derived circuit to the main circuit, and a generator driven thereby and supplying the current for the fields of the battery of Faradic machines, substantially as set forth.

2. The combination of a battery of Faradic generators, a separate generator for supplying the field-current thereto, and an independent motor for the latter, said independent motor being actuated by current from the battery of Faradic generators, substantially as set forth.

This specification signed and witnessed this 26th day of February, 1881.

THOS. A. EDISON.

Witnesses:

S. D. MOTT,

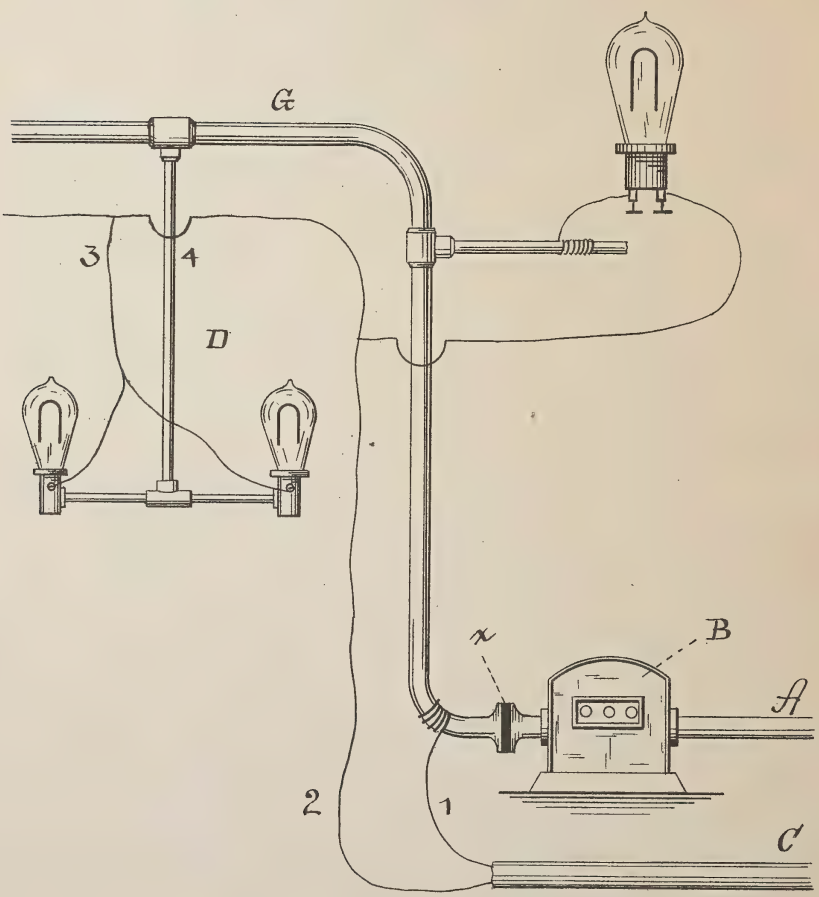
H. W. SEELY.

(No Model.)

T. A. EDISON.

SYSTEM OF ELECTRIC LIGHTING.

No. 251,551. Patented Dec. 27, 1881.



WITNESSES:

O. D. Mott

M. J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

SYSTEM OF ELECTRIC LIGHTING.

SPECIFICATION forming part of Letters Patent No. 251,551, dated December 27, 1881.

Application filed August 30, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electric Lighting; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

In a system of furnishing light and power by electricity it may be sometimes convenient to utilize the system of gas pipes and fixtures already existing in a house as conductors for the current without interfering, if so desired, with their legitimate use. The object of this invention is to furnish means for so doing. The main conductors of electricity enter the house, and at a point beyond the gas-meter one of them is connected with the main gas-pipe, an insulating-joint being formed in the pipe between this point and the meter, in order to prevent the current from passing through the meter to the ground. The other wire passes through the house to the various translating devices, at each of which a branch from the main wire form together a multiple-arc circuit, in which is placed a lamp or other translating device. This is shown in the annexed drawing, in which C is the main street-conductor of electricity leading into the house, and A that of gas, having the meter B placed in it. The electric wires branch, one being connected to the interior gas-pipe G, while the other leads to the various parts of the house to be supplied with current.

In order that a ground-circuit may not be formed through the meter, the joint x is formed of insulating-material, so that no current can pass in that direction. The circuit is thus formed by the pipe G and wire 2, and derived circuits are formed therefrom, as at D, which represents a fixture containing lamps. Here a branch, D, leads from G, and a branch, 3, from 2, forming a derived or multiple-arc circuit to the fixture, from which others may be formed to each lamp. The insulated wire may pass through the chandelier or fixture to form these circuits, or may lie parallel with or be wound around it.

What I claim is—

1. A complete or round metallic circuit for houses, one main branch or conductor of which is the system of gas-pipes of the house, electrically disconnected from the earth, while the other main branch or conductor is formed of insulated wire, substantially as set forth.

2. The combination, in an electric circuit within a house, of a gas-pipe having an insulating-joint, a wire conductor connected thereto upon the house side of such joint, and a wire conductor leading through the house, substantially as described.

This specification signed and witnessed this 21st day of May, 1881.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
RICHD. N. DYER.

(No Model.)

T. A. EDISON.

UNDERGROUND CONDUCTOR.

No. 251,552. Patented Dec. 27, 1881.

Fig. 1.

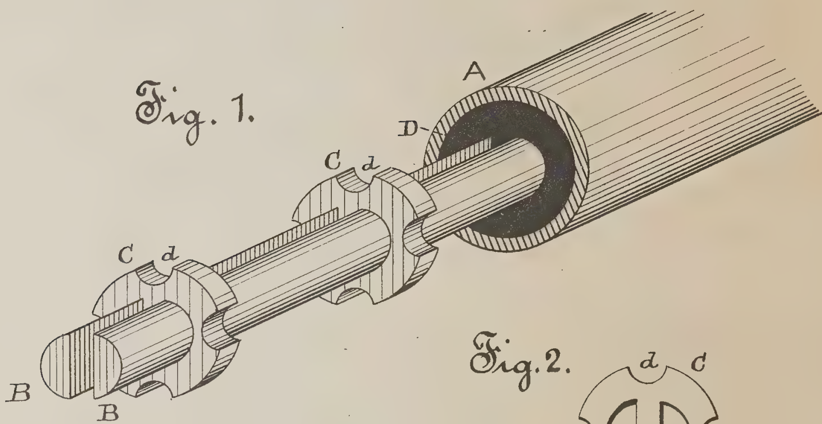


Fig. 2.

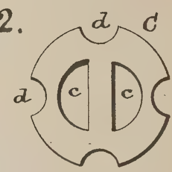


Fig. 3.

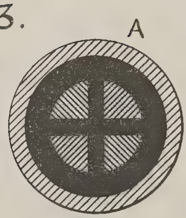


Fig. 4.

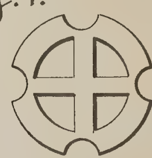


Fig. 5.

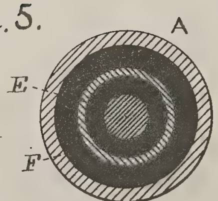


Fig. 6.

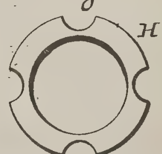
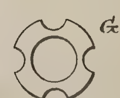


Fig. 7.



Attest:

S. D. Mott

H. W. Seely

Inventor:

T. A. Edison

per

Dyer and Wilber

Attys.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

UNDERGROUND CONDUCTOR.

SPECIFICATION forming part of Letters Patent No. 251,552, dated December 27, 1881.

Application filed April 26, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Underground Conductors; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In my system of furnishing electric light and power to a large number of consumers from one central station it is preferable that the conductors which convey the current to the various translating devices in circuit should be laid underground. Some method, therefore, is necessary by which these conductors can be completely insulated and protected from injury by moisure and other causes. This is the object of the present invention, which, generally speaking, is as follows: The two conductors which form a circuit from and to the place of supply consist of copper rods or bars or tubes which are placed in pipes or tubes of iron of considerably larger diameter. Washers of a suitable insulating material, preferably paper or pasteboard, are placed around and between the conductors, so as not to allow any electrical contact between the conductors themselves, or between a conductor and the metal of the exterior pipe, and the remaining space is filled with asphalt or a similar non-conducting substance, or compound of various substances, so that a perfect insulation is attained. The washers or disks above noted are made with notched edges, so as not to close up the entire cross-section of the tube, so as to enable the insulating compound to enter all parts of the tube. Appropriate arrangements of this kind are shown in the accompanying drawings.

Figure 1 is a view in perspective of a street-main, a portion of the inclosing-tube being removed to afford a view of the conductors; Fig. 2, a sectional view of the insulating washer of Fig. 1; Figs. 3 and 5, sections of other forms of mains; and Figs. 4, 6, and 7, sections of washers used therewith.

In the drawings, A is a pipe or tube, of iron or other suitable metal.

B B, Fig. 1, are copper bars or rods, whose diameters vary according to the number of translating devices to be supplied, but together are much less than the internal diameter of the inclosing-pipe A.

C C are washers, of some such insulating material as paper or pasteboard, what is known as "Manila board" being very suitable therefor, it being as effective as glass for this purpose, with the advantage of more easy manipulation and great economy in cost. These have apertures C C (see Fig. 2) of the same shape as the conductors, which pass through them, fitting closely therein. These washers are of such size that they also fit closely within the tube A and prevent contact between the conductors and the inside of the tube. The space D, which surrounds the conductors between the washers, is filled with any suitable insulating material, asphalt or an asphalt composition being appropriate substances for this purpose, this also filling the spaces between the conductors themselves, the edges of the washers containing notches *d d*, so that apertures are left to enable the insulating compound to flow through the entire length of the tube. Various-sized completed conductors may be made; but as the sizes vary the arc of the circular portion of the conductors should vary, so that the arc of the conductors is always concentric with that of the inclosing-tube, securing a uniform thickness of insulating material between the two.

By using the form of washer shown in Fig. 4 four conductors may be placed in one tube, as in Fig. 3.

Instead of both conductors being solid rods, the arrangement shown in Fig. 5 may be used. In this case one conductor is a tube, as E, through which passes the other, a round rod, F, a pasteboard washer, G, Fig. 7, being placed between them, and a larger washer, H, Fig. 6, between E and A, the remaining spaces being filled with an insulating substance, as above described.

It is evident that any number of different forms of conductors, washers, &c., may be used in addition to those herein described, as may be desired.

By these devices I am enabled to obtain a complete and permanent insulation between the conductors themselves, and also between the conductors and the exterior tube, the latter at the same time preventing any injury from moisture, dampness, or other causes which might affect the conductors or the insulation thereof from reaching the same.

What I claim is—

1. The combination, with an inclosing-tube and electrical conductors contained therein, of washers made of Manila or paste board, supporting the conductors and separating them from the tube and from each other, and notched upon their exterior edges to permit the flow throughout the tube of liquid insulating material, substantially as set forth.

2. A compound electric conductor in which the individual conductors are solid metallic bars, formed each as a segment of a circle, and both separated from each other, and supported within an inclosing-tube by disks or washers of insulating material, substantially as set forth.

3. A circuit for electric currents in which one conductor is a hollow tube and the other a solid circular rod passing through the said tube, and insulated therefrom and supported therein, and separated therefrom by insulating disks or washers, substantially as set forth.

4. A metallic circuit for electric lights, consisting of two semicircular rods supported by and separated from each other in a metallic pipe by a series of insulating-washers, the pipe being filled with a suitable insulating material, substantially as set forth.

5. A metallic circuit composed of semicircular rods secured within but insulated from a metallic containing-tube, the arcs of the conductors and the tube being concentric, substantially as set forth.

This specification signed and witnessed this 22d day of April, 1881.

THOS. A. EDISON.

Witnesses:

WM. H. ALDEN, Jr.,
H. W. SEELY.

(No Model.)

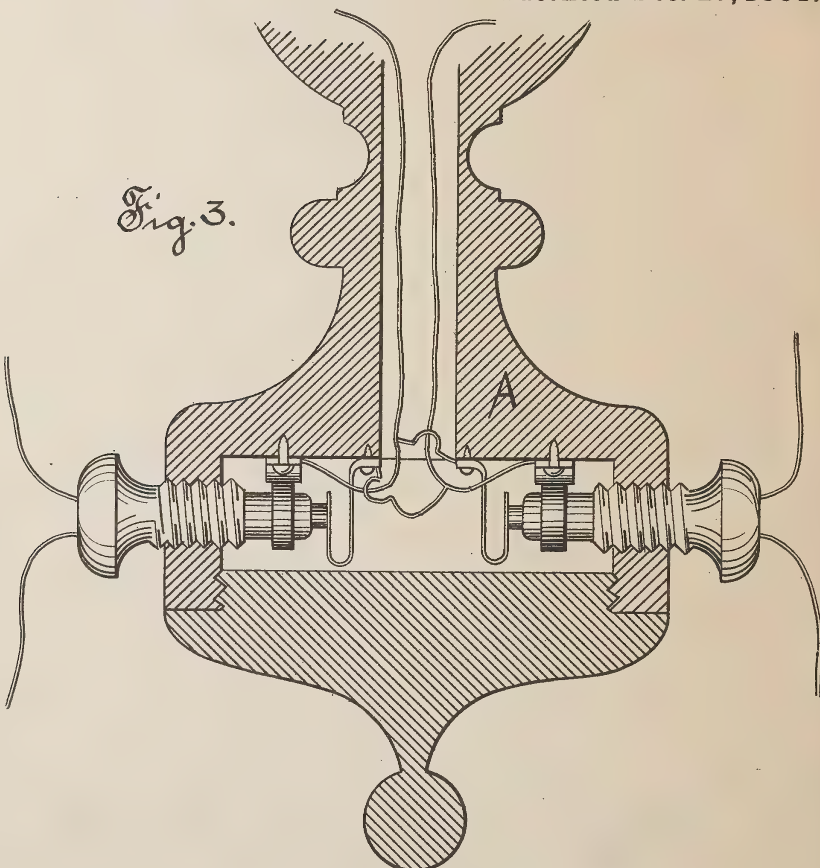
2 Sheets—Sheet 2.

T. A. EDISON.

ELECTRIC CHANDELIER.

No. 251,553. Patented Dec. 27, 1881.

Fig. 3.



Attest:

O. D. Mott

H. W. Seely

Inventor:

T. A. Edison

per Dyer & Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC CHANDELIER.

SPECIFICATION forming part of Letters Patent No. 251,553, dated December 27, 1881.

Application filed March 26, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Electric Chandelier; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In an electric lighting system using incandescent lamps it is often desirable to group a number of them, two or more, for which purpose a device like the ordinary gas-chandelier is exceedingly useful; and the invention in this case relates to what may be called an "electrical chandelier."

A chandelier consisting of a body and two or more arms, often highly ornamented, is not in good shape for packing and shipment. Hence it has become customary to make the ordinary gas-chandeliers so that they come apart into many pieces, which may be packed securely and compactly for shipment, and then reassembled. Manufactured goods of all classes are so made, and are usually designated in the trade as "knockdown goods." With gas-chandeliers the task is an easy one, as the "circuit," so to speak, for the fluid is simply a pipe, and it is only necessary to see that the junctions are tightly screwed together. With an electrical chandelier a complete electrical circuit must be made to each lamp or burner.

The object of this invention is to furnish an electrical knockdown chandelier, so arranged with circuit-connections and contacts upon or in its various parts that the act of assembling the parts to form the chandelier shall at the same time complete the necessary electrical connections.

A further object of the invention is to utilize wood or any suitable insulating material capable of economical manipulation and ornamentation in the manufacture of chandeliers and other electric-lamp fixtures.

Suppose that the chandelier is to be of metal or that an ordinary gas-chandelier is to be changed into a knockdown electrical chandelier. The chandelier is composed of three elements—the arms carrying the lamps or burners, of which there may be any desired number; the standard and attached base into which the arms are fastened, and the ornamentation, usually of struck-up metal or ornamental castings, slipped over or fastened upon the standard and arms. Through each arm the two conducting-wires are passed, being either left free at the outer end for attachment to the lamp-socket, or, if the socket is then secured in position, attached thereto. The inner end of the arm is screw-threaded for attachment to the base. Beyond the screw-threaded end extends an insulating block or tube terminating in a metal tip, to which one of the conductors is fastened. Upon the exterior of the block is a metal ring, to which the other conductor is led. Within the base attached to the pendant or standard of the chandelier is fixed a block of insulating material serving as a base for the parts to be therein placed; or they may be insulated from each other by a special insulation to each. Near to the location of each arm, and in such position within the base that the metal tip and ring shall impinge thereon when the arm is put in position, are two springs. One is somewat J-shaped, with its longer member bent at right angles, forming a shoulder by which it is fastened to and depends from the base, its free or spring member being toward the periphery of the base. The other is a curved or bowed spring of sheet metal, rigidly fixed at one end to the base, and secured at the other by a screw passing through a slot, so that it may be more or less bowed. The main conductors pass down through the standard of the chandelier to the base, at which point they branch at each arm, a branch from one main conductor being connected to the pendent spring, while a branch from the other is connected to the curved spring. When the arm is screwed into place the metal tip upon its end impinges against the pendent spring, while the ring takes upon the curved spring, the resilience of these parts insuring good contact, so that the necessary circuit-connections are immediately and automatically formed.

I have found that tasteful and inexpensive chandeliers may be made of wood, which may

be ornamented with the ordinary metal ornamentations, when desired. Such, however, may be turned or carved so that the ornamentations of the standard and base are integral therewith and the base hollowed out to form a chamber for receiving the circuit-completing devices described.

In the drawings, Figure 1 is a section, and Fig. 2 a bottom view, of a part of a chandelier constructed as a knockdown electrical chandelier; and Fig. 3 shows a wooden chandelier.

A is the standard or leading-tube of the chandelier, through which pass the main conductors 1 2, and which is surrounded by any ornamental casing C or other desired ornamentation. Attached thereto is the base B for the reception and support of the burner or lamp-carrying arms D D′, of which there may be any necessary number. Upon its interior is the insulating-base *b*, to which are attached springs E E′ G H, there being one spring, E, and one spring, G, for each arm. E is made as a pendent spring, secured at one end, with the free end bent upward toward the periphery of the base, while G H are bowed flat springs, rigidly secured at one end, and at the other by slots in which take screws *g h*, so that their height or bow in the center may be varied. To each spring E E′ and G H a branch from a conductor leads, care being taken that the branches leading to the springs E G or E′ H of each set shall be from different main conductors.

The arms are all alike, and the description of one answers for all. The arm D is arranged to be screw-seated in the base, and it carries upon its inner end the insulating-block *d*, at whose end is fixed the metal tip F in contact with one, 4, of the conductors leading through the arm to the lamp. Upon the exterior of the block *d* is secured a metal band or ring, *e*, to which the other conductor, 3, is secured.

The springs E G and the tip F and ring *e* are so arranged relatively to each other that when the arms are put in position the parts shall be as shown in Fig. 1—viz., with F and E in contact and G and *e* in contact, these contacts being rendered firm and reliable by the resilience of the springs E G. In these figures the conductor 1 branches to spring E of one arm and to spring H in the other, and conductor 2 to spring E′ in one case and spring G in the other. One conductor, however, may branch to all the springs of one type and the other branch to the springs of another type.

One set of springs and one conductor may be used where metal chandeliers are used, the metal of the chandelier and its connected system of pipes being used for the return system, although it is preferable in systems of incandescent lighting to use a complete wire-circuit.

It is evident that many modifications may be made in the form and arrangement of the contact and springs, the feasibility of making a "knockdown" electrical chandelier being here shown. For instance, the tip F may be a lug upon *d* to strike against a shoulder, or G may be a semicircular or circular projection upon the base in which *e* is to take, or F may be a spring. The number of such modifications, evident to an ingenious mind, is almost beyond cataloguing.

In Fig. 3 is shown a chandelier made of wood or other insulating material, in which the standard A is turned or carved into proper shape.

The base B may be a piece separate from or integral with A, and the arms D may be of wood or metal, as desired. The base B being of wood, the insulating-piece *b* can be dispensed with.

The arms D and base and standard may each be made and sold as separate articles of manufacture, so that repairs of any broken or damaged part of the chandelier may be readily made without its removal from its location.

What I claim is—

1. An electrical knockdown chandelier consisting of a stem, a base provided with a set of contact springs or plates for each arm of the chandelier, and arms each provided at its inner end with an insulating-block carrying contact-terminals for the wires of the arm, and adapted to form electrical contact with the proper set of springs or plates when placed in position, substantially as set forth.

2. The combination of a chandelier-arm provided at its inner end with an insulating part upon which are secured metallic plates, blocks, or springs, forming one set of terminals of a wire-circuit within the arm, and a base provided with contact plates or springs with which the plates, blocks, or springs of the arm form electrical contact when the arm is placed in position, substantially as set forth.

3. An electrical chandelier arm provided with conductors therein, an insulated inner end, and circuit-terminals arranged thereon, to which the wires are electrically connected, substantially as set forth.

4. The combination, in an electrical chandelier, of a standard or support, A, carrying a set of conductors, those of one or the main circuit, a base provided with a series of contact plates or springs, one set for each arm, connected in multiple arc to the main circuit, and an arm or arms for carrying the lamps, each provided with conductors, and with an insulated end carrying contact-plates arranged to complete circuit with the proper set of contacts in the base, substantially as set forth.

5. A chandelier-base provided with an insulated plate, and having secured thereon contact plates or springs, as described, each set forming terminals of a derived circuit, substantially as set forth.

6. An electrical knockdown chandelier in which each part intended to be separable is provided with an insulated portion carrying or supporting contact plates or springs, form-

ing the terminals of its wire conductors, and arranged to complete circuit with its neighboring portion when the two are secured together, substantially as set forth.

7. The combination, in an electrical chandelier, of a wooden body and arms and conducting-wires secured within perforations therein, substantially as set forth.

This specification signed and witnessed this 7th day of March, 1881.

THOS. A. EDISON.

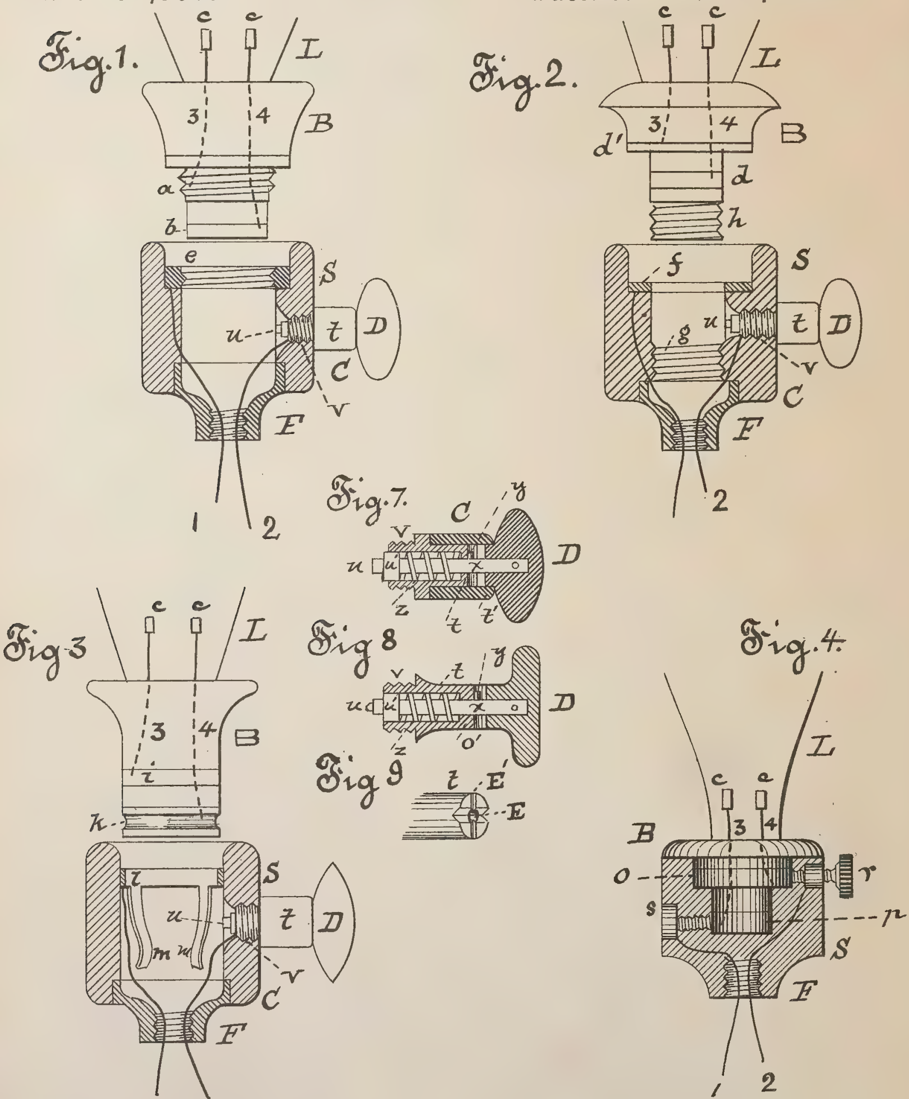
Witnesses:
H. W. SEELY,
S. D. MOTT.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

ELECTRIC LAMP AND SOCKET OR HOLDER.

No. 251,554. Patented Dec. 27, 1881.



Attest

O. D. Mott

H. W. Seely

Inventor —

Thos. A. Edison

per Dyer & Wilber

Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

ELECTRIC LAMP AND SOCKET OR HOLDER.

No. 251,554. Patented Dec. 27, 1881.

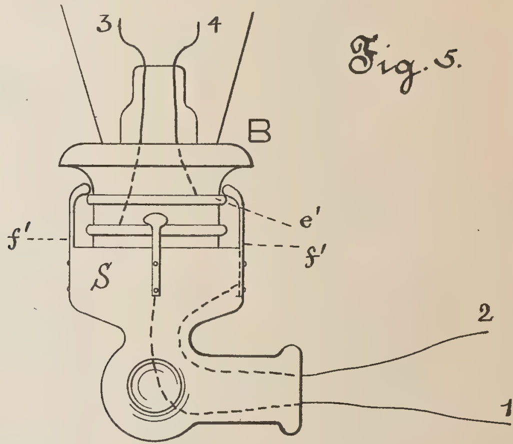


Fig. 5.

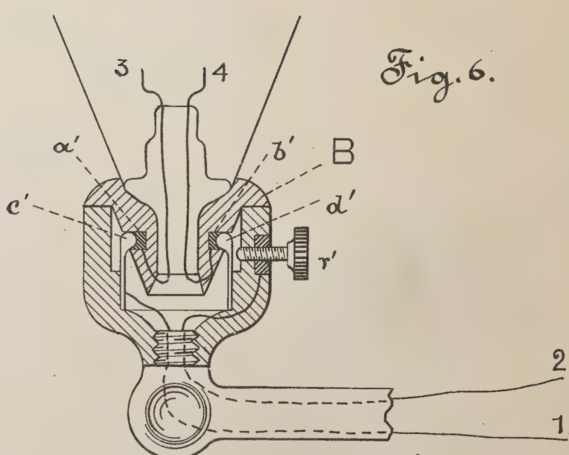


Fig. 6.

Attest:

O. D. Mott

H. W. Seely.

per

Inventor:

T. A. Edison

per Dyer & Wilber

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC LAMP AND SOCKET OR HOLDER.

SPECIFICATION forming part of Letters Patent No. 251,554, dated December 27, 1881.

Application filed March 26, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps and Sockets or Holders; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In a system of electric lighting where the lamps used consist of an incandescing conductor hermetically sealed in a glass inclosing-globe it is desirable that the lamp and its supporting-socket should be so constructed that the lamp may be readily removed from or placed in the socket, and that at the same time by the act of placing in or removing the lamp from the socket the appropriate circuit-connections to the conductor be formed, subject, however, and only, to the control of a suitable circuit-controller for throwing the current through the lamp when desired. Such an arrangement of a separate complete removable electric lamp and suitable socket or holder is shown in application No. 2,172, hitherto filed by me. In such the lamp is held to the socket by the friction between the neck of the lamp and the socket. It is desirable, however, to sometimes reverse the ordinary relation in space of the lamp and socket—that is, to hang the lamp from the socket or to support the lamp horizontally—in order that the light therefrom may be unimpeded beneath the lamp by any shadow-producing parts. In such an event a more positive and reliable connection than friction is desirable between the lamp and its socket or holder, to furnish which is the object of a portion of this invention. This may be accomplished in the following manner: Secured to the glass neck of the lamp is a second neck, designated hereinafter, the neck made of any suitable insulating material, upon the exterior of which are fastened two metal bands, one clamp of the incandescing conductor being connected electrically to one band, and the other clamp to the other band. One of the bands is formed into a male screw-thread. The socket is also made of insulating material hollowed out to receive the neck from one end and formed with a screw-thread at the other end, by which it may be attached to any ordinary gas-fixture, chandelier, or bracket. The socket is provided with a suitable circuit-controller, preferably such a one as is hereinafter described, to which one of the main conductors is connected. Upon the interior of the socket is a metal band, which may be formed into a female screw-thread, and to which leads the other main conductor. One or two turns of the screw-thread is sufficient, and the parts are so arranged and proportioned that when the lamp is placed in position one of the metal bands upon the neck takes upon and forms contact with one within the socket, while the other band upon the neck is in position to be impinged upon by the circuit-controller when manipulated. Another method, instead of forming one of the neck-bands into a screw-thread, is to make it concave, and to attach to the band or ring within the socket curved spring-fingers, which shall take therein and hold the lamp firmly within the socket; or the insulated neck may be beveled slightly and two concavities made therein, one on either side, in the bottom of which are metal plates, to which lead the wires from the two clamps of the incandescing conductor. From the bottom of the interior of the socket two spring-fingers rise, terminating in small balls, which take and are held into the concavities by the resilience of the spring-fingers; or upon the exterior of the neck a ledge or projection may be formed, over which slip spring-fingers attached to the outside of the socket. All these forms serve to carry out the idea of this invention, holding the lamp securely within its socket irrespective of the relative position of the two.

A circuit-controller is also desirable, in which arrangement or provision is made to indicate when it is in best position to complete or to break the circuit, and to retain it securely in such position until it be positively and designedly moved therefrom, to furnish which is the object of another portion of this invention. This is accomplished in the following manner: The circuit-controller is seated in the wall of the socket, and forms the socket terminal of one of the conductors leading thereto. The part seated therein should be screw-threaded

for attachment to the socket, and is made hollow for a portion of its length. Through it and its otherwise solid outer head passes a rod carrying the contact-point upon its inner end, and terminating upon the outside in a suitable thumb-piece of insulating material. The solid outer head has two grooves or indentations extending across its diameter at right angles to each other, one being somewhat deeper than the other. These have beveled sides, in order that a pin secured to and extending from the rod before mentioned may be easily forced therefrom by force applied to the thumb-piece. Near the inner end of the rod is a washer, against which takes a spiral spring wound around the rod, so that it forces the rod inwardly as far as is permitted by the pin thereon. When the rod is turned by the thumb-piece so that the pin takes in the deeper indentation the spring forces the rod inwardly sufficiently to close the circuit, while when the pin takes in the shallower the circuit remains open, in either event, however, the stress of the spring holding the pin in the indentation or groove into which it has been turned against any accidental displacement.

The construction of the neck and socket for the lamp and of the circuit-controller is clearly shown in the drawings, in which—

Figures 1, 2, 3, 4, 5, and 6 show the forms of neck and socket, and Figs. 7, 8, and 9 details of the circuit-controller.

In Figs. 1, 2, 3, 4, 5, and 6, S is the socket, made of insulating material, hollowed out to receive the neck B of lamp L, the lamps being indicated by lines representing their lower portion only. The socket is provided with the screw-theaded end F, made of a separate piece, attached to the socket or made integral with the socket for attachment to any suitable support or fixture.

Secured in the socket is the circuit-controller C, formed as follows: t, its stem, is a cylinder of insulating material, screw-threaded at one end, V, for its securement to S, over which, if desired, may be sleeve t', of insulating material, as shown in Fig. 4. The outer end of the cylinder is a head, o', solid, except for an aperture, through which passes the rod x, carrying contact-point u. Upon the rod x is a head or washer, u', and forming or bearing against which takes the spring z, wound around x, and serving to force u u' out from t. Upon the head o of t are cut the diametrical grooves E E′, of which one, E, is much deeper than the other, as shown, both having inclined or beveled sides. A pin, y, attached to and extending out from x, takes in these grooves. Upon its extreme outer end the rod x should be provided with an insulating thumb-piece, D. From this it will be seen that as D is turned the stress of the spring z pulls y into one of the grooves, and holds it there, unless force be applied sufficient to raise it therefrom; that when the pin y falls into E the extra depth thereof permits the spring to force u out farther than when the pin takes in E′, and these distances are so proportioned that when the pin y is in E the circuit shall be closed, and broken when the pin y is in E′.

In Fig. 1 two metal bands or rings, a b, are put upon the neck B, one of which, a, is formed into a male screw-thread. From these bands in all the forms shown wires 3 4 lead to the clamps c c of the incandescing material.

Upon the interior of the socket, Fig. 1, is the metal band e, formed into a female screw-thread, to which is connected the main conductor 1, the other main conductor, 2, being connected to C. The act of placing B within S and fastening it therein by the screws a e completes also the circuit-connections, one branch then being 1 e a 3 c; the other being 2 S b 4 c.

In Fig. 2, d d' are the rings or bands upon the neck connected to c c, the screw-thread being formed separately therefrom at h and integral with the body of the neck, if desired. When placed in position the band or ring d' takes upon and contacts with f in the socket, completing the circuit 1 f d' 3 c, while d is in position for C to complete the circuit 2 C d 4 c.

In Fig. 3, i k are the rings or bands upon the neck, k being formed into a concavity. l is a ring within S, from which extend curved springs m, rounded at their outer extremities. When placed in position the figures m take in the concavity of k, holding the two parts together, while at the same time a circuit, 1 l m 4 c, is completed, and i is in position for C to control the circuit 2 C i 3 c.

In Fig. 4 the bands o p on B are plain, a screw, s, being turned to take against p, completing circuit 1 s p 3 c, and at same time holding the lamp and socket together, while o is put in position for r—a simple screw circuit-closer—to control the circuit 2 r o 4 c. It is to be noticed that the arrangement of the bands in these forms, one above the other, insures proper connections, irrespective of the relative position of any two points in the same longitudinal or transverse plane of the lamp and socket, and obviates the necessity of careful adjustment present when the contact-plates are in the same longitudinal or transverse plane.

In Fig. 5 a shoulder, e', is formed upon the exterior of B, over which slide and take fingers f', attached to S, whereby the two are held together.

In Fig. 6 the lower part of B is beveled, at the top of the bevel grooves or concaves a' b' being made upon opposite sides, in the bottom of which are metal plates x x x, connected to c c by the conductors 3 4.

Extending upwardly from the base of S are spring-fingers c' d', ending in small balls, (or the ends thereof may be simply curved,) to one of which, c', is connected the main conductor 1. When the parts are placed in position the round or ball ends of c' d' take into the concavities of B, holding the two parts to-

gether while one circuit is completed *via* 1 c' a' 3 c, and d' is in such position that r may control the other *via* 2 r' d' 4 c.

By any of these forms the lamp is held to its socket in so firm a manner that the lamp may be placed in any desired position relatively to its socket or holder, while the act of placing or holding or removing the lamp completes or destroys automatically the circuit-connections therethrough.

What I claim is—

1. The combination, with an incandescent electric lamp and its socket, detachable from each other and adapted to be used in a complete or round wire circuit, of controllable means for positively holding them in position together, and means for automatically completing the circuit-connections between them through both limbs or members of the circuit upon placing them together in position, substantially as set forth.

2. An incandescent electric lamp having contact plates or rings upon its neck or base, arranged one above the other on the base of the lamp, forming the terminals of both limbs or members of a complete or round wire circuit, substantially as set forth.

3. The combination, with a separate removable incandescent electric lamp and its socket, of means for holding them positively in position relatively to each other, substantially as set forth.

4. A circuit-controller for an electric lamp, provided with a pin adapted to take in properly-arranged grooves or notches in the cylinder of the controller, thereby retaining it in position to make or break the circuit, as desired, and against accidental displacement, substantially as set forth.

5. A circuit-controller consisting of a cylinder, a rod therein, a spring adapted to project the rod from the cylinder, and means, as described, for limiting and determining at will the action of the spring upon the rod, substantially as set forth.

6. In a circuit-controller for electric lamps, the combination of a cylinder with grooves, as described, upon its head, a spring-acted contact-rod passing therethrough, and a pin attached to the rod and taking in the grooves, substantially as set forth.

This specification signed and witnessed this 7th day of March, 1881.

THOS. A. EDISON.

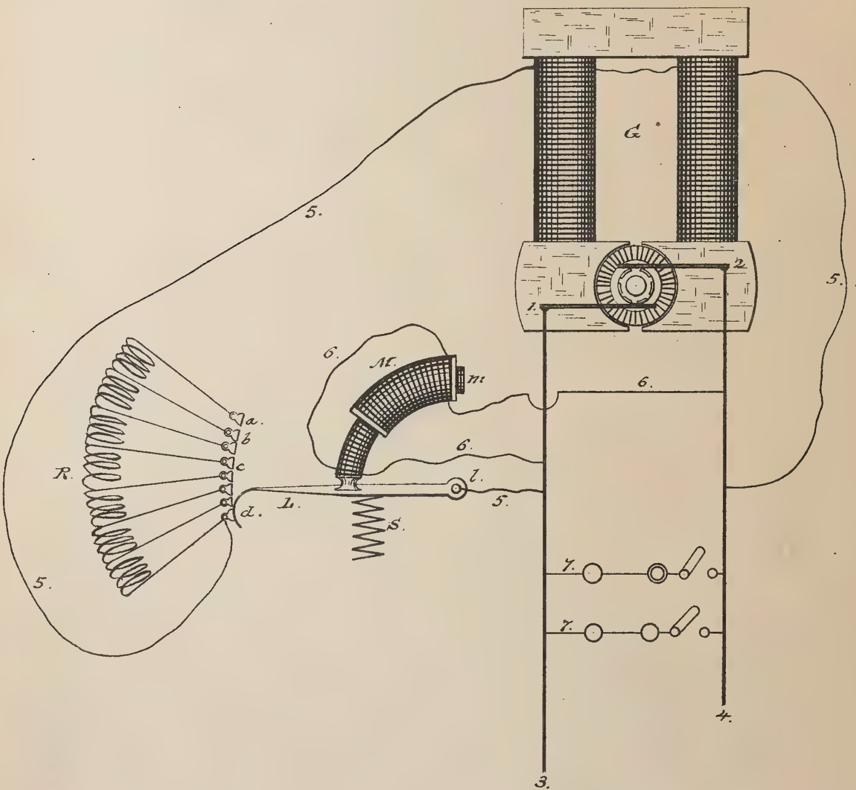
Witnesses:
H. A. BARR,
E. D. ALTHUS.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 251,555. Patented Dec. 27, 1881.



Attest:

S. D. Mott

H. W. Howard

Inventor:

Thos. A. Edison

per. Dyer & Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 251,555, dated December 27, 1881.

Application filed May 27, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This invention relates to means for automatically controlling the generative force of a magneto or dynamo electric machine, so that the amount and only the amount of current needed in the circuit may be supplied thereto, and the pressure or electro-motive force maintained constant in the circuit. To accomplish this a resistance and switch or lever, by which the circuit may be made independently of or through more or less of the resistance, are included in the circuit energizing the field-of-force magnets. The switch or lever is attached to a magnet playing within a longitudinal opening in a helix, the magnet and helix preferably being longitudinally the segment of a circle and forming an axial magnet, the interior magnet tending, when both are at a maximum of intensity, to place itself so that its center and the center of the coil correspond, in which position it places the switch or lever so that the field-circuit is through all the resistance, while a spring attached to the switch serves, when unresisted, to hold the switch or lever so that it cuts the resistance out. Both coils of this axial magnet are in a circuit derived from the main or consumption circuit. No translating devices being in circuit, the entire exterior circuit is through the coils of the axial magnet only, and it acquires a maximum magnetization, putting all the resistance in the field-circuit, thereby keeping production or generation down to a given point. If, now, translating devices be put in circuit, more exterior circuits are closed and the amount of current flowing through the axial-magnet circuit is lessened, weakening the force of the electro-magnet so that the spring causes the lever or switch to move so as to cut out a portion of the resistance, which is equivalent to strengthening the field-circuit, thus arresting the diminution of current due to putting on more lamps. This is illustrated in the drawings, in which one generator of the dynamo type is shown; but it is to be understood that the principle and means are equally applicable to any type of generator, and to them used singly, or to a number used as a battery.

G is a generator, from whose commutator brushes or springs 1 2 leads the main or consumption circuit 3 4, a derived circuit, 5, therefrom being led around the field-magnets of the generator, in which circuit are included a resistance, R, and switch or lever L.

In a derived circuit, 6, is included the helix M, in which plays, forming the core thereof, the magnet *m*, attached to and moving in one direction the switch or lever L against the resilience of the spring S.

In derived circuits 7 lamps or other translating devices are placed. If these latter circuits be open, whatever current is generated finds its only exterior circuit through 6 M *m*, magnetizing them strongly. Hence *m* is drawn up within M, causing L to contact with R at about *a* or *b*, so that all or nearly all of R is included in the field-circuit 5, so weakening it that the generative force of G is kept at a given point. If 7 be closed, it takes a part of the current, lessening the amount through 6, weakening the force of M *m*, the spring pulls L to, say, *c*, cutting out part of the resistance, strengthening the field-circuit, which results in a proportionate increase of generation of current. As more circuits are closed L is carried from contact to contact of R until finally all or nearly all or as much of R is cut out as is necessary to compensate for the increased demand.

Upon cutting out of 7 the reverse operation takes place.

What I claim is—

1. The combination, with a generator, of a variable resistance in its field-circuit, a magnet in a derived circuit to the main or supply circuit of the generator, and a movable contact-arm controlled by the magnet for effecting an automatic regulation of the field of the generator, substantially as set forth.

2. The combination of a generator, a resist-

ance in its field-circuit, an axial magnet composed of a helix and an electro-magnet as a core thereto, both included in one circuit derived from the main or supply circuit, and a movable contact-arm controlled by the magnet and contacting with the resistance, substantially as set forth.

This specification signed and witnessed this 26th day of February, 1881.

THOS. A. EDISON.

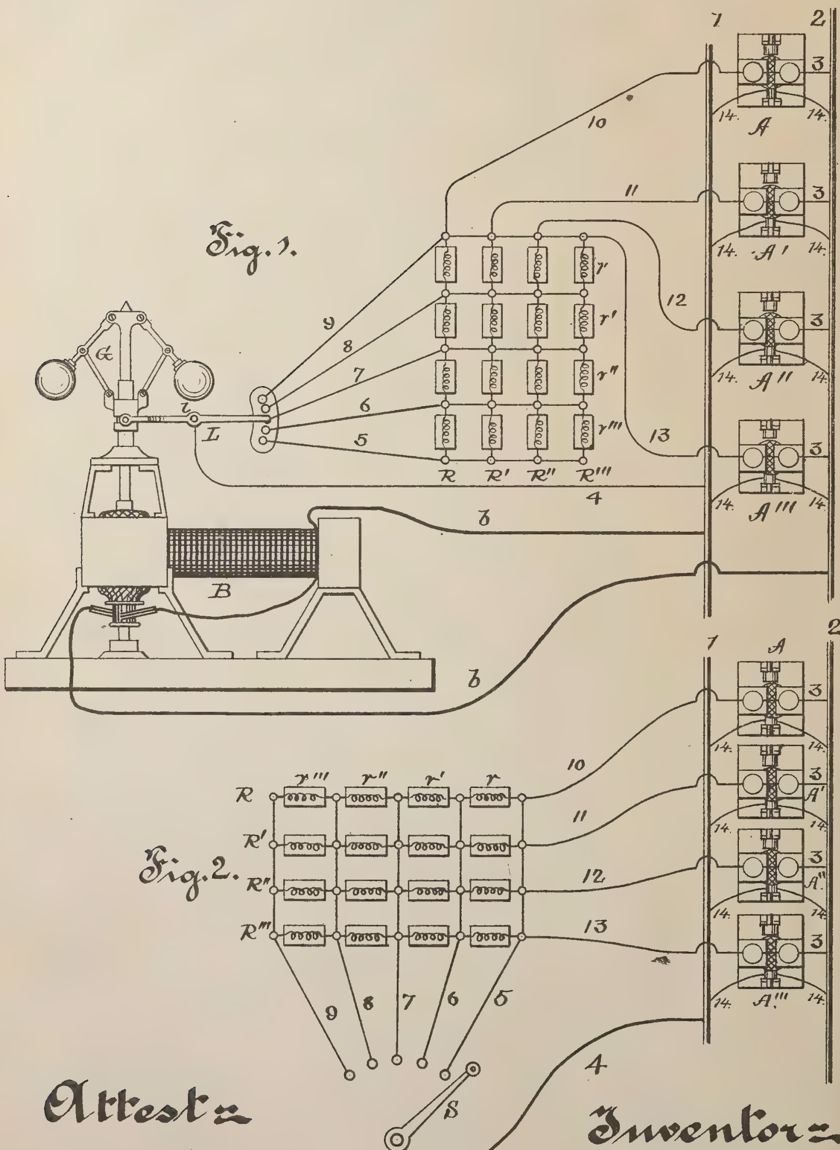
Witnesses:
H. W. SEELY,
RICHD. N. DYER.

(No Model.)

T. A. EDISON.

REGULATOR FOR MAGNETO OR DYNAMO ELECTRIC MACHINES.

No. 251,556. Patented Dec. 27, 1881.



Attest:

S. D. Mott

C. L. Clarke.

Inventor:

Thos. A. Edison per Dyer and Wilber Attys

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR MAGNETO OR DYNAMO ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 251,556, dated December 27, 1881.

Application filed October 30, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Magneto or Dynamo Electric Machines, (Case No. 258;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

As explained in a prior application for patent by me made, the current used in my system is generated at and distributed from a central station to and through the district of such station. At the central station is massed a number of generators sufficient to supply the wants of the entire district. As shown in the application referred to, these generators are connected in multiple arc, and the generative capacity of those in use is regulated and controlled by regulating and controlling the current passing through the coils of the field-of-force magnets by introducing into a circuit common to all the field-of-force coils more or less resistance. In this instance the invention consists in arranging equal resistances in the circuit of each field-of-force coil and cutting in or out equal portions of each simultaneously by hand or automatically, the result being accomplished in the latter case by the use of a special electric engine placed in a derived circuit to the main circuit, and provided with a governor which, on lessening or increase of speed, actuates a switch, cutting in or out a portion or all of the resistances.

In the drawings, which are mainly diagrammatic, Figure 1 is a view of the automatic arrangement, and Fig. 2 a view of the arrangement wherein the resistances are controlled by hand.

1 2 represent the main-circuit conductors at and leading from a central station, where is shown a battery of four dynamo-electric machines, A A′ A″ A‴, which number may be greater or less, as desired.

14 14 are the connections from the armature of each generator to the main circuit 1 2, for throwing thereinto the current generated in the coil of the revolving armature. From each field coil one conductor, 3, leads directly to main conductor 2. From conductor 1 a wire, 4, leads, in one instance to the hand-switch S, in the other to the switch-lever L.

Sets of resistances R R′ R″ R‴ are used, one for each generator, a conductor leading from each set of resistances to its appropriate generator—for instance, 10 from R to A, 11 from R′ to A′, 12 from R″ to A″, and 13 from R‴ to A‴. Each set of resistances may consist of as many resistance-boxes as desired. For illustration, four only are shown, r r' r'' r''', conductors being arranged, in connection with the hand-switch S or switch-lever L, to cut more or less out of circuit. If either be turned to 9, all the resistances are cut out of circuit; at 8, r only is placed in circuit; at 7, r and r'; at 6, r, r', and r'', while at 5 all are thrown into circuit. The path of the circuit to the field-coils then is from 1, *via* 4, to S or L, thence through one of the conductors 5, 6, 7, 8, or 9, when it divides and passes by 10, 11, 12, and 13 to A, A′, A″, and A‴ to 2. By this arrangement the resistance of all the exterior field-circuits is always equally increased or diminished, their relative resistances remaining unchanged, while each field is rapidly, accurately, and delicately adjusted, correspondingly affecting the generative capacity of the machine.

In Fig. 1, B is an electric engine in a derived circuit, b b, to the main circuit. Upon the shaft of its armature is a governor, G, to which is connected the switch-lever L, pivoted at l. The speed of the armature and of its attached governor depends upon the current passing through b b. If an insufficient amount is generated, the speed falls, the governor-balls drop, moving L, so that it contacts with 8 or 9, causing an increased current through the field-coils, and a consequent increase of strength of magnetic field and of generative capacity. If an excessive amount of current is generated, the reverse takes place.

While the generators here shown are connected as dynamos, it is evident that the same arrangement is equally applicable to and efficacious with magneto-electric generators, and that the wire 3 might lead to a special generator set apart for the work of supplying current for the fields only, the wire 4 of course being led to the same machine.

What I claim is—

1. The combination, with each generator of a battery of magneto or dynamo electric machines arranged in multiple arc, of a resistance in its field circuit and a switch controlling equally and simultaneously all the resistances of the generators of the battery, substantially as set forth.

2. The combination of a battery of dynamo or magneto electric machines, a series of equal resistances, one series for each generator, a switch, a circuit to the switch, and resistances and special circuits, one for the field of each generator, from the resistances to the field-of-force coils of the generators, substantially as set forth.

3. The combination of a battery of magneto or dynamo generators, a series of resistances in the field-circuits, one for each generator, and means for automatically controlling equally and simultaneously the resistances of the field-circuits of all the generators, substantially as set forth.

This specification signed and witnessed this 21st day of October, 1880.

THOS. A. EDISON.

Witnesses:
CHAS. BATCHELOR,
WM. CARMAN.

(No Model.)

T. A. EDISON.

WEBERMETER.

No. 251,557. Patented Dec. 27, 1881.

Fig. 1.

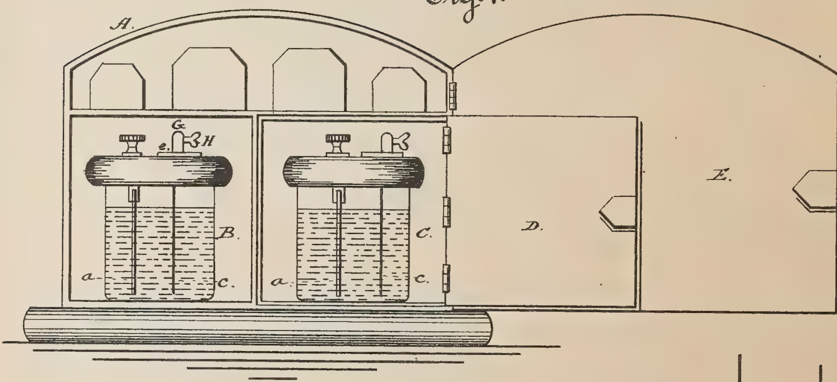


Fig. 2.

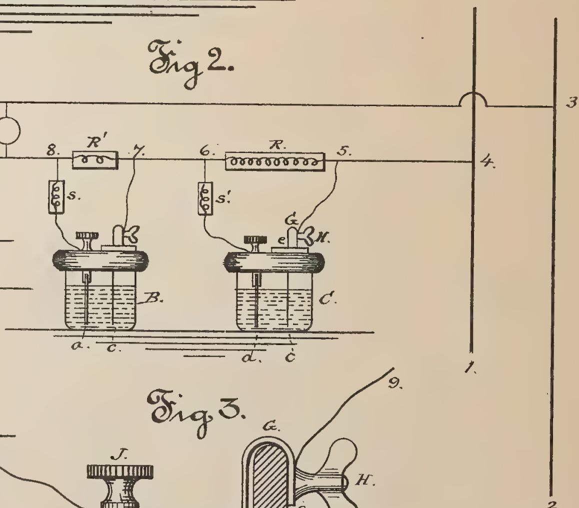


Fig. 4.

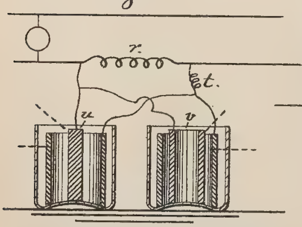
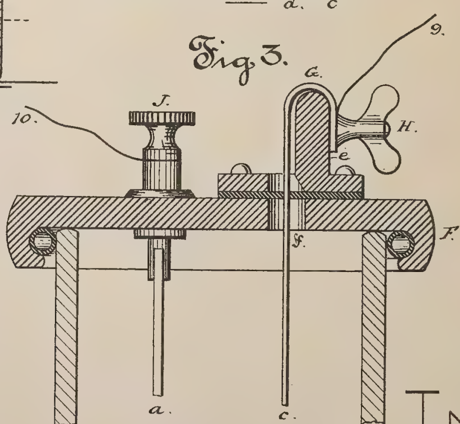


Fig. 3.



ATTEST:

D. D. Mott

H. W. Seely

INVENTOR:

T. A. Edison

per Dyer and Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

WEBERMETER.

SPECIFICATION forming part of Letters Patent No. 251,557, dated December 27, 1881.

Application filed May 27, 1881. (No mod 1.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Webermeters; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to apparatus for measuring the quantity of electric current passing through a circuit in a given time, and is one of those devices to which in prior patents I have applied the name "Webermeter."

It has for its object the insuring of greater accuracy in recording when in various conditions as to temperature.

My arrangement generally consists of an electro-depositing cell, the anode and cathode of which are plates whose weight has been carefully determined. It is placed in a shunt-circuit to that of which the current is to be measured, the latter containing a resistance, so that a definite proportional part of the current will be shunted through the cell. After the lapse of a proper interval of time the cathode and anode plates are weighed and the difference in weight noted, this difference showing the amount of current which has passed through the shunt. In practice it is preferable, because more convenient, to weigh only the cathode and its increase noted, whence the current passing through the cell may be determined, and as it is proportioned to the current in the main circuit the latter is then readily ascertainable. Upon passage of the current through the cell the fluid therein is heated. It may be to a very small extent, still it is heated somewhat. This heating diminishes the resistance of the cell, and consequently a proportionately increased amount of current passes therethrough, making an appreciable source of error. To remedy this a resistance should be used in the cell-circuit equally susceptible to the heating influences of the current, but whose resistance increases as it is heated. By this means, as the resistance of the cell is diminished, the artificial resistance in its circuit is increased, so that the entire resistance of the shunt or electro-depositing circuit is maintained constant. For this purpose a fine copper wire answers well. This resistance must be proportioned to that of the cell. For instance, if the latter contains a twenty per cent. solution of copper sulphate, the copper-wire resistance must be three times as great as that of the cell, in order that they may continue to balance and render nugatory the effects of a rise and fall of temperature.

In practice it may be well to use two cells, in one of which the deposition takes place with greater rapidity than in the other, the former being opened, inspected, and weighed at proper intervals, while the latter is kept locked and used as a "check-meter," to insure absolute correctness in the charges and to protect the seller of electricity from fraud.

Suitable devices for carrying my invention into effect are shown in the drawings, in which—

Figure 1 is a sectional view of a box or case containing two cells, which constitute a meter; Fig. 2, a sectional view of the two cells, showing the circuit-connections and resistances; Fig. 3, a section of two cells of another form which may be used; and Fig. 4, a detail view, in section, of a portion of one cell.

A is a box containing the two electro-depositing cells B C, one of which, B, is arranged to deposit with greater rapidity than the other, this being easily accomplished by varying either the size of the plates, their distance apart, the strength of the solution, or the amount of current shunted through it. The box has two doors, one of which, D, incloses only the cell C, which is intended to be kept locked, while the outer door, E, is opened for inspection of the cell B.

In Fig. 2, 1 2 are the main conductors, from which a derived or multiple-arc circuit, 3 4, leads into a house in which the meter B C is placed for measuring the current passing through the house. Resistances R R′ deflect portions of the current into the shunt-circuits 5 6 and 7 8, the resistance R′ being less than R, so that a greater current enters the cell B than that which passes through C.

a a are the anode and *c c* the cathode plates, the former being arranged so as to be withdrawn from the cell, while the latter is permanently fixed therein.

S S′ are resistances, of fine copper wire, placed in the shunt-circuits.

In Fig. 3 the arrangement for readily removing the cathode-plate is shown. A projection, *e*, with a rounded top, extends above the top F of the cell, and the cathode-plate is made with a curved or hooked portion, G, which hangs over *e*, and is secured by a thumb-screw, H, which also serves to secure the wire 9. The cathode passes through an aperture, *f*, into the cell. The anode is held firmly, connections thereto being made from the wire 10 by means of a set-screw, J.

The operation of these devices is as follows: Current passing through the shunt-circuit 7 8 deposits copper on the cathode *c* of the cell B. The heating effects of the current are proportional in the solution and in the resistance S; but while the resistance of the solution is diminished thereby the resistance of S is increased—that is, if the resistance S be properly proportioned to that of the solution, as hereinbefore set forth, its increase of resistance automatically compensates for the decrease of resistance of the solution, the result being that the total resistance of the circuit is maintained constant, so that the proportion of current passing therethrough remains fixed.

When measurements are desired the door E is opened to obtain access to the cell B, the thumb-screw H is loosened, and the plate C raised from the cell, and its increase of weight determined. From this the current passing through the main line is computed.

If it is desired to substantiate or prove the indications of the cell B, the cell C is examined and its cathode weighed, this cell being arranged to allow of a smaller amount of deposition than the cell C. For convenience the two cells are so arranged and adjusted that the rate of deposition in one is a multiple of that in the other. A convenient arrangement for this is shown in Fig. 4, where cylindrical plates are used, the cathode-plates *u v* being of different diameters, making in one cell the distance from anode to cathode much greater than in the other. Of course the diameter of the cathodes might remain constant and that of the anodes be varied to produce the same result. As shown, these two cells are arranged while each is in its own branch circuit, so as to require but one shunting resistance *r* and but one compensating resistance *t*.

What I claim as my invention is—

1. A webermeter consisting of two electro-depositing cells, each in a separate derived circuit of the common main circuit, one of which deposits with greater rapidity than the other, substantially as and for the purposes described.

2. The combination, with an electro-depositing cell, of a resistance whose increase automatically compensates for the decrease in resistance of the cell due to the action of the current, substantially as set forth.

3. The combination, in an electrolytic cell, of a plate having a curved or hooked exterior extremity, a cover for the cell having an aperture through which said plate may be passed, a projection secured to the cover contiguous to the aperture and extending upwardly to receive the hooked or curved extremity of the plate, and a set-screw mounted thereon, substantially as and for the purposes set forth.

4. The combination, in a webermeter, of two electro-depositing cells, the plates in one being a greater distance apart than are those in the other, substantially as and for the purposes set forth.

This specification signed and witnessed this 19th day of May, 1881.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

RICHD. N. DYER.

(No Model.)

T. A. EDISON.

WEBERMETER.

No. 251,558 Patented Dec. 27, 1881.

Fig. 1.

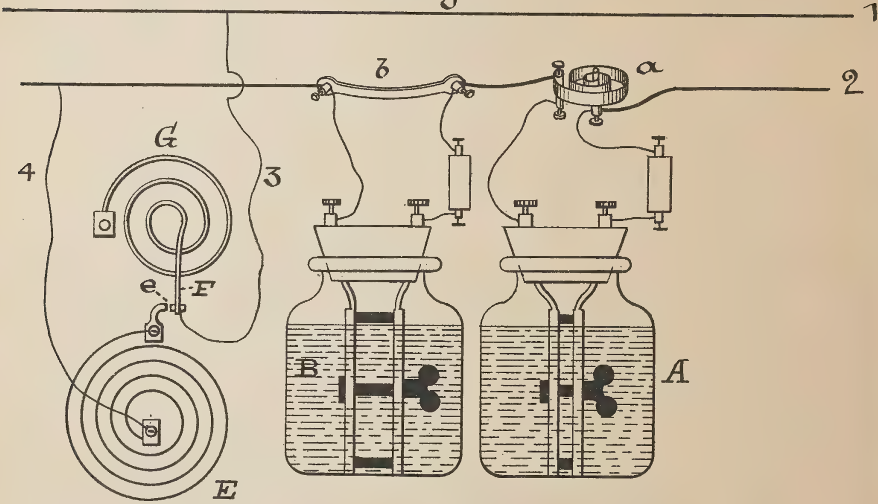
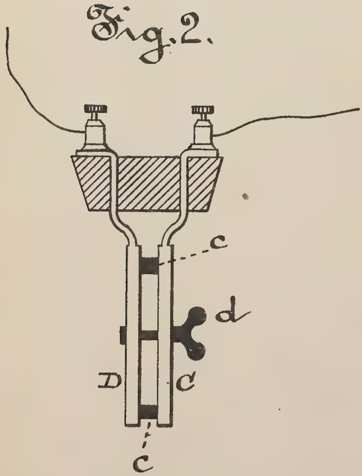


Fig. 2.



WITNESSES:

O. D. Mott
J. E. Clark

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

WEBERMETER.

SPECIFICATION forming part of Letters Patent No. 251,558, dated December 27, 1881.

Application filed August 30, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Webermeters; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of my invention is to produce a webermeter which will have the temperature within the inclosing-case so automatically regulated that the solution in the electrolytic cells cannot reach the freezing-point, which low temperature would render the cells inoperative; and, further, to so construct and arrange the plates in the cell that they may be retained securely at a definite fixed distance apart. The first object I accomplish by placing in the box which incloses the meter a carbon or metallic resistance, situated in a space common to both cells of the meter if more than one cell is used, and arranged in a derived circuit, in which is placed an automatic thermo-circuit regulator, which closes the circuit when a definite low temperature is reached—for instance, 10° above the freezing-point of the solution contained in the cell. The carbon resistance is heated by the passage of the current, but not sufficiently to be destructive of the same, and the temperature of the meter is maintained above the freezing-point of the solution.

The thermo-circuit regulator may be a spring carrying a lever on its free end, which lever is thrown by the contraction of the spring against a contact-point, completing the circuit in which the carbon resistance is placed. When the temperature rises the spring expands and the circuit is broken, and it is closed again by the fall of the temperature. The plates of the electrolytic cells are maintained at a definite distance apart by simple means. For this purpose I place between the plates blocks of non-conducting material which are of a definite thickness, representing the distance it is desired to keep the plates apart, and such plates are removably clamped upon the blocks by means of a screw, also of non-conducting material, hard rubber being suitable for this purpose. The meter is preferably provided with two cells, one of which, having its plates placed farther apart and having a smaller proportion of the current shunted through it, will deposit only a small proportion of what the first cell deposits, and may be used as a check upon the first cell.

In the drawings, Figure 1 is a view showing the arrangement of the cells and carbon resistance; Fig. 2, a separate view of the plates of one cell and the stopple-connections.

1 and 2 are the main conductors, in shunt-circuits from which are arranged the two electrolytic cells A B. The resistances *a b* (preferably of German silver) shunt portions of the current through the cells. In the shunt-circuit of the cells are fine-wire resistances which counterbalance the increase and decrease in the conductivity of the cells due to variations of the temperature. The plates C D of the cells are separated by non-conducting blocks or strips *c*, and are clamped removably upon such blocks or strips by screws *d*, of non-conducting material. The plates of cell B are placed farther apart than those of A, and the resistance *b* is made less than *a*, so that the deposit in cell B is small in proportion to that in A. For instance, B may be arranged to deposit in six months the same amount A will deposit in one month, and B can be examined at the end of that time and used to check the accounts based on the monthly examination of A.

In the meter-box is placed the carbon resistance E, which is made of carbonized paper, or of other suitable material, or of a suitable metal. This carbon resistance is in the derived circuit 3 4, in which is also placed the lever F and contact *e*. The lever F is carried by the free end of a coiled spring, G, which is adjusted to throw F against *e* when a certain low temperature is reached—as, for instance, ten degrees above the freezing-point of the solution.

It is obvious that instead of carbon resistance exposed to the air one of my lamps containing a filament of carbon may be used to heat the electrolytic cells.

What I claim is—

1. In an electrolytic-cell webermeter, a carbon or other resistance heated by an electric current and arranged in proximity to the cell or cells, for maintaining the temperature of the

solution above the freezing-point, substantially as set forth.

2. In an electrolytic-cell webermeter, the combination of a carbon or other resistance arranged in proximity to the cell or cells, and an automatic thermo-circuit regulator for making and breaking the circuit of the resistance, substantially as set forth.

3. In an electrolytic-cell webermeter, the combination of a carbon or other resistance arranged in proximity to the cell or cells, and an automatic thermo-circuit regulator composed of a spring and contact-lever, for making and breaking the circuit of the carbon or other resistance, substantially as set forth.

4. The combination, with the plates of an electrolytic cell, of insulating blocks or strips for holding them a definite and fixed distance apart, and removable insulating-clamps for binding the plates and blocks or strips together, substantially as described.

This specification signed and witnessed this 20th day of May, 1881.

THOS. A. EDISON.

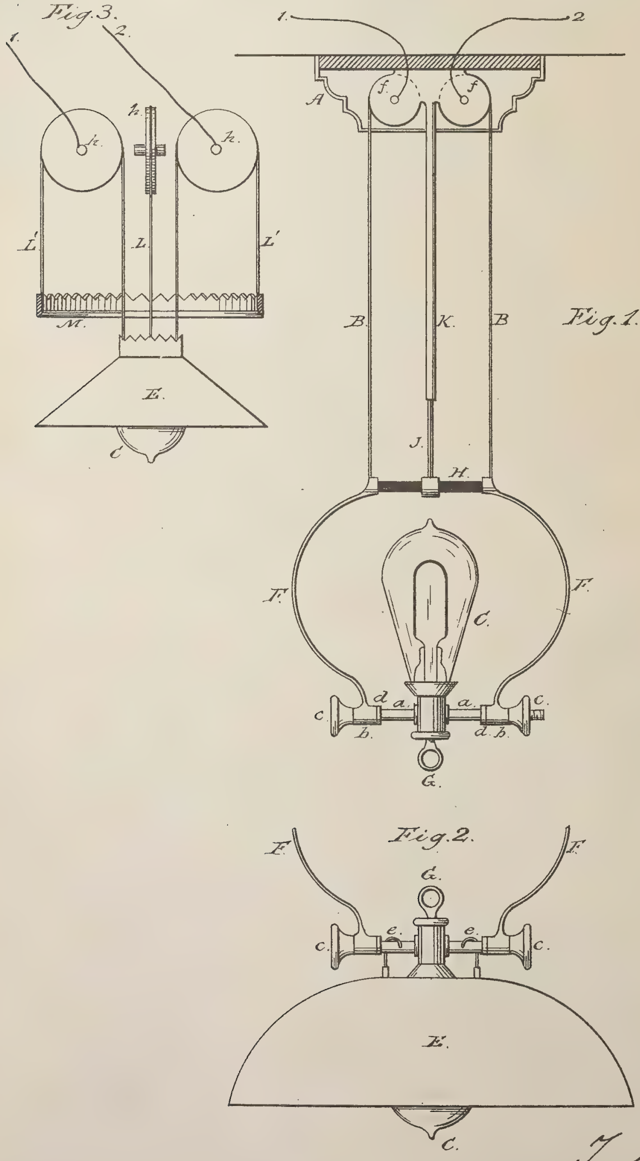
Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

ELECTRICAL DROP LIGHT.

No. 251,559. Patented Dec. 27, 1881.



Attest;

F. W. Howard

M. J. Clagett.

T. A. Edison

Inventor;

per Dyer & Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRICAL DROP-LIGHT.

SPECIFICATION forming part of Letters Patent No. 251,559, dated December 27, 1881.

Application filed November 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Drop-Lights; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to construct a chandelier to be used with incandescent electric lamps, so that the lamp may be raised or lowered, and so placed at such a height as may at any time be desired; and, also, that the lamp may either stand upright or hang pendent, as may be most expedient. To accomplish these objects the lamp is held in a suitable frame, consisting of two conducting side pieces and a rod joining them at the bottom, on which the lamp is placed, this rod being capable of turning over in its supports, so that the lamp may be turned upside down. The rod is formed of conducting material, except at its middle, where is an insulating portion, the leading-in wires of the lamp being connected, one to each of the conducting portions of the rod. The frame is suspended by means of metal bands passing over wheels or rollers attached in any suitable way to the ceiling, the conductors which convey the current to the lamp being connected with these bands. The wheels may contain a spring for raising the frame, as is common with window-curtains, or a weight may be used as a counterpoise for raising and lowering the frame and lamp. A rod is also attached to but insulated from the frame, sliding in a hollow tube fastened to the ceiling, in order to assist by its friction in holding the frame at the proper height against the force of gravity.

In the accompanying drawings, Figure 1 is a view of a chandelier or fixture constructed according to my invention. Fig. 2 shows a portion of the same with the lamp inverted, and Fig. 3 a section of a fixture in which a counterpoise-weight is used.

C, Figs. 1 and 2, is an incandescing electric lamp, rigidly secured to and supported upon a rod, which consists of two metal portions, *a a*, the inner ends of which are connected to the leading-in wires of the lamp, the middle of the rod being formed of insulating material. The rod is supported in metal bearings *b b*, placed between the shoulders *d d* and thumb-screws *c c*.

The ends of the rod are screw-threaded, so that the thumb-screws *c c* may be removed and the rod taken from its supports.

As stated, the rod rotates easily in its bearings, so that the lamp may be inverted, as in Fig. 2, a suitable shade, E, then being suspended from the rod by hooks *e e*.

A ring, G, is attached below the lamp for drawing down the frame, and may be so arranged that the circuit may be closed or opened and the lamp lighted or extinguished by turning it; or any of the ordinary forms of circuit-controllers described by me in prior applications may be used for this purpose.

The bearings *d d*, in which the rod *a a* turns, are, as seen, the extremities of side pieces, F F. They are made to touch the rod on every side, so as to retain contact in whatever position the lamp is placed. The side pieces are of conducting material, and are suspended by metal bands or ribbons B B, Fig. 1, which pass to the spring-rollers *f f*, which are of metal, and to which are also connected the conductors 1 2, the rollers being placed in any suitable box or casing, A, attached to the ceiling.

At their upper ends the side pieces, F F, are joined by a bar of insulating material, H, suspended at its middle by a rod, J, which protrudes from the hollow tube K, this tube being attached to the ceiling above, and the rod J fitting therein so closely as to produce considerable friction.

The lamp and frame are drawn down by means of the ring G, the bands B B unwinding from within the rollers, and, when desired, may be drawn up by the springs, the friction of the rod J within its inclosing-tube K helping to sustain them at the proper height.

In Fig. 3 a different arrangement is shown. Instead of using the spring-rollers described, I here make use of sheaves or grooved wheels *h h h*, of conducting material, over which pass metal bands L L′ L″, one end of each being attached to the lamp C, with its shade E, while from the other is suspended a band or ring, M, of insulating material, and of such weight that it balances the lamp and shade and holds them at the height at which they may be placed. It may be made of such configuration as will make it an ornament to the

fixture. The conductors 1 2 pass to the centers of two of the sheaves, being connected thereto in such way as not to interfere with their turning. The current thus passes to the metal bands L′ L″ and by them to the lamp.

It is evident that two or four wheels may be used instead of the three shown.

I do not herein claim, broadly, an electrical chandelier having two sides insulated from each other, and connected each respectively with one terminal of a line-wire and the contact-strip of an incandescent lamp, as such forms the subject-matter of a prior application.

What I claim as my invention is—

1. In a chandelier or bracket for incandescent lamps, the combination, with the two sides insulated from each other, and each connected respectively with one terminal of a line-wire and the contact-strip of an incandescent lamp, of means for varying the position vertically of the lamp within the limit of the length of the sides, substantially as set forth.

2. The combination, with an incandescent lamp, of two supporting sides or strips insulated from each other, and made as conductors, and arranged and constructed to retain the lamp at any desired height within the limit of movement of the sides or strips, substantially as set forth.

3. The combination, with an electric lamp, of metallic bands or cords, insulated from each other, supporting the lamp and acting as conductors thereto, and means acting upon the bands or ribbons to render the position of the lamp vertically adjustable within the limit of the length of the bands or cords, substantially as set forth.

4. The combination, with an electric lamp and metallic conducting-supports therefor, of means, as described, for adjusting the lamp to an upright or a reversed position, or to a position at any angle thereto, substantially as set forth.

5. The combination of an electric lamp, metallic conducting-supports therefor, means, as described, for adjusting and holding the lamp in a reversed position, and a shade provided with means for attachment over the lamp when in reversed position, substantially as set forth.

This specification signed and witnessed this 25th day of October, 1881.

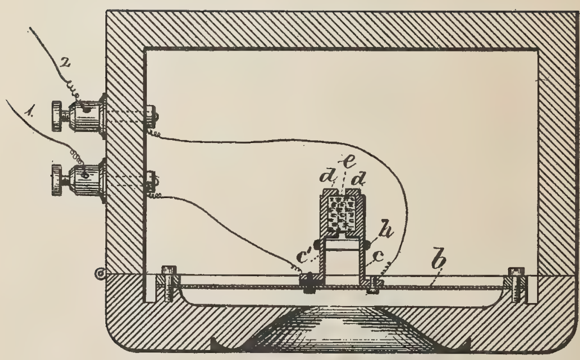
THOMAS A. EDISON.

Witnesses:
Wm. H. Meadowcroft,
H. W. Seely.

T. A. EDISON.

TELEPHONE.

No. 252,442. Patented Jan. 17, 1882.



Witnesses,

S. L. Griffin

John Kruesi

Inventor

Thomas A Edison

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 252,442, dated January 17, 1882.

Application filed August 6, 1879.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Telephones, of which the following is a specification.

In this telephone the button of finely-divided conducting material is between metal cups on arms secured to the diaphragm, and the pressure on the carbon button is varied by the outward movement of the diaphragm, causing the ends of the arms to move slightly outward and lessen the pressure on the carbon, and this pressure is increased when the ends of the arms are brought toward each other by the return movement of the diaphragm.

In the drawing I have shown a horizontal section of the telephone. The mouth-piece *a* and diaphragm *b* are of usual character. *c c'* are metal arms or supports secured to the diaphragm *b*, and the ends of these arms are made as cups to receive the carbon button *e*. One of these arms is insulated from said diaphragm, so that the current passes by wire 1, arm *c'*, carbon *e*, arm *c*, and wire 2 to line. The ends of the arms or supports *c c'* are kept pressed against the ends of the carbon button either by the spring of the arms or by a rubber band, *h*, passed around the spring-arms.

When a sound-wave strikes the diaphragm the diaphragm is bowed outwardly and causes the ends of the arms to be farther apart than when the diaphragm is at rest; consequently the pressure on the carbon is lessened, and thus weakens the electric current passing over the line; but as the diaphragm returns to its normal position the ends of the arms are again drawn toward each other, and increase the pressure on the carbon button, and the tension of the electric current on the line is also increased. Thus all the sound-waves striking the diaphragm are translated into electric waves of corresponding character as to pitch and amplitude.

I employ a flat carbon of the character represented in other applications heretofore filed by me.

I claim as my invention—

The combination, in a telephone, of a diaphragm, two spring-arms attached to the same, one of which is insulated, a carbon button between the said arms, a contractile spring applied to the arms, and the circuit connections, substantially as set forth.

Signed by me this 4th day of August, 1879.

THOS. A. EDISON.

Witnesses:

S. L. GRIFFIN,

FRANK MCLAUGHLIN.

(No Model.)

T. A. EDISON.

TELEPHONE.

No. 257,677. Patented May 9, 1882.

Fig. 1.

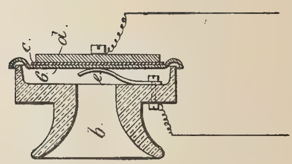
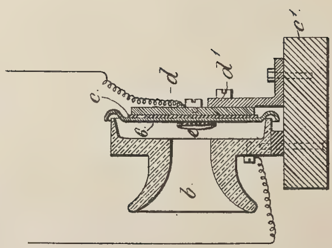


Fig. 2.



Witnesses

Chas. H. Smith

J. Hail

Inventor

Thomas A. Edison

per Lemuel W. Serrell atty

N. PETERS. Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 257,677, dated May 9, 1882.

Application filed October 17, 1881. (No model.) Patented in England June 15, 1878.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Telephones, (Case No. 158 B,) of which the following is a specification.

This application is a division of my application No. 158, filed November 11, 1878, and the said division is made for the purpose of separating from said original application matters that are not in interference, and for separating the different features of invention into two additional applications. The present I term "Case No. 158 B."

Letters Patent in Great Britain No. 2,396 show the present devices. Said patent was applied for June 15, 1878, but the specification was not filed until December 13, 1878.

This portion of my invention relates to the telephone-instrument represented in the accompanying drawings, Figure 1 being a sectional view and Fig. 2 a section at right angles to Fig. 1.

The transmitting-instrument to which this portion of my invention relates is intended to transmit oral communications over electric circuits.

In my original application No. 158 I have shown a receiving-instrument and electric circuits; but as this transmitter may be used with any suitable circuits or receiving-instrument, these parts do not form a necessary feature of this division of my said application.

In my application No. 130, filed April 27, 1877, the diaphragm is in direct contact with a surface of plumbago or similar material.

In my Patent No. 203,015 a tension-regulator is described, composed of fiber and an electric conducting material—such as plumbago.

In my Patent No. 203,016 I have described a button of lamp-black forming the tension-regulator, and there is a metallic plate intervening and in contact with both the carbon and the diaphragm.

The peculiar features of the present invention as distinguished from the aforesaid devices relate to a telephonic diaphragm that is not clamped at its edges, but rests at one side against a support, and it is held in place by a yielding pressure applied to the other surface, and the tension-regulating device is applied between the diaphragm and the support, so that the pressure upon the tension-regulator will be varied by the vibrations of the diaphragm as acted upon by articulate speech or other sounds, and the electric condition of the line will be varied, so that the current will undulate in a corresponding manner to the sound-waves.

In the drawings, the plate or diaphragm 6 rests against a tension-regulating device—such as a disk of fibrous substance, *c*—say, silk—with finely-divided material—such as plumbago—worked into its fibers. There may be several such disks, and the plate *d* is at the opposite sides of these disks *c*, and it is sustained in place by suitable means. I have shown a bracket, *d'*, connected to a base, *c'*, which is fastened to the mouth-piece *b*. The spring *e* serves to press the plate or diaphragm 6 toward the tension-regulator, so as to apply the proper initial pressure. One conductor is connected with the back plate, *d*, and the other to the spring *e* or diaphragm 6. The sound-waves act against the plate or diaphragm 6 and vibrate the same, and the resistance in the electric circuit is varied according to the action of the vibrating diaphragm on the tension-regulator. The edges of the diaphragm or plate 6 are preferably corrugated or turned over behind the back edges of the mouth-piece, as represented. This stiffens the edges of the diaphragm and prevents any independent or false vibrations at said edges.

I claim as my invention—

1. A tension-regulating device, a support for the same, a diaphragm resting against the tension-regulator, and a spring-presser acting to retain the diaphragm in place, substantially as specified.

2. In a telephone a diaphragm, the whole of which is free to vibrate under the action of sound, a tension-regulating device at one side of the diaphragm, a mouth-piece, and a spring acting to press the diaphragm toward the tension-regulator, substantially as set forth.

3. In a telephone-instrument, a diaphragm that is corrugated or ribbed at or near its edges, substantially as set forth.

4. In a telephone, the combination, with the diaphragm, of a yielding tension-regulator at one side and a yielding presser acting against the other side.

Signed by me this 7th day of September, A. D. 1881.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

(No Model.)

T. A. EDISON.

MAGNETIC ORE SEPARATOR.

No. 263,131. Patented Aug. 22, 1882.

Fig. 1.

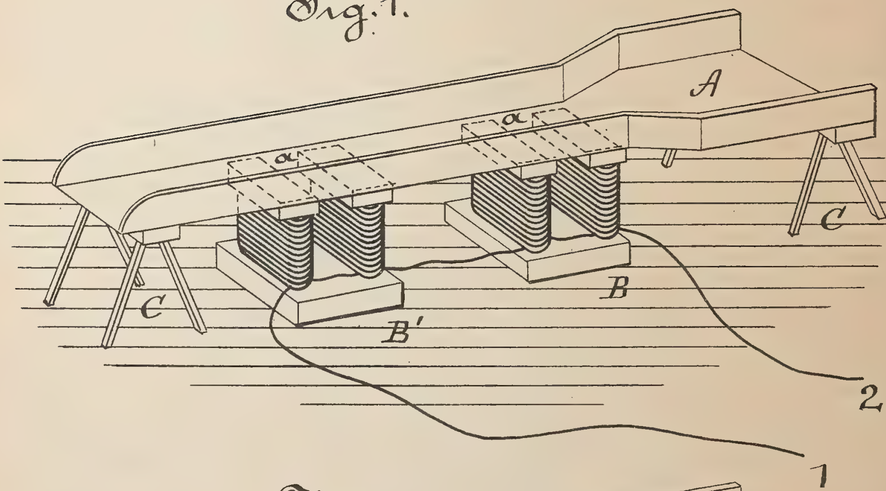
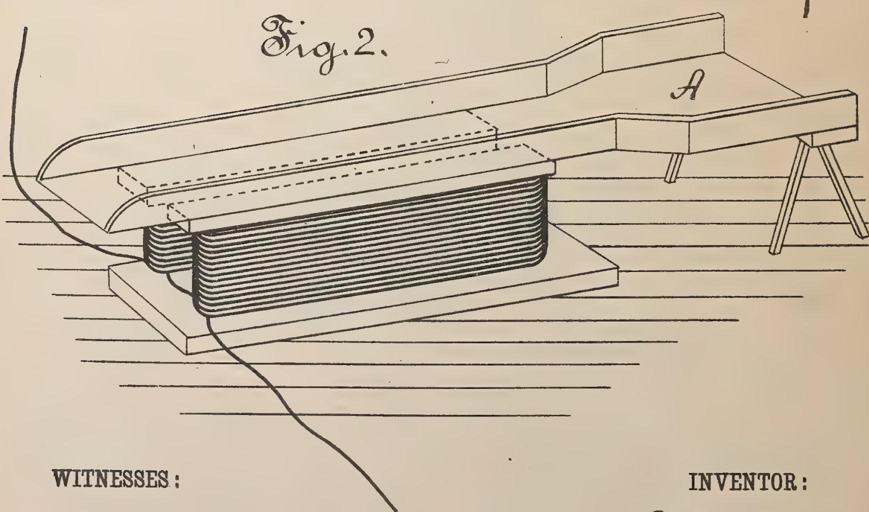


Fig. 2.



WITNESSES:

O. D. Mott
M. J. Clagett.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MAGNETIC ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 263,131, dated August 22, 1882.

Application filed June 22, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Magnetic Ore-Separators, (Case No. 329;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In my Patent No. 228,329, granted June 1, 1880, I have shown an apparatus for the separation of magnetic from non-magnetic substances. The present invention has in view the same object, but may be used in connection with hydraulic mining. The mingled magnetic and non-magnetic substances, accompanied by a stream of water, enter the upper end of an inclined trough or sluice, beneath which are placed a series of powerful magnets. When the magnetic substances pass above these magnets their motion is arrested and they collect at these points, while the remainder of the mixture is washed down to the end of the sluice.

One use of the invention is in the separation of magnetic iron from the sand and other substances which are usually found mixed therewith; and it may also be used in connection with hydraulic gold-mining, in which case the magnetic substances, which are always mingled with the auriferous material in sufficient quantities for the purpose, are held at various points in the bottom of the sluice-box and there form riffles for stopping the gold, these riffles being preferable to those ordinarily used, because they will never wear out, their substance being recruited by fresh supplies of material as fast as the first is carried away.

Convenient devices for carrying my invention into effect are shown in the annexed drawings, in which Figure 1 is a view in perspective of such a sluice or trough, while Fig. 2 shows a different arrangement of the magnets.

A is a suitable trough or sluice supported on proper standards C C in an inclined position. This trough may be of any desired material. If of magnetic material—as iron—it forms polar extensions of the magnets hereinafter referred to, while if it be of non-magnetic material the magnets act therethrough sufficiently to accomplish the result desired.

B B are powerful horseshoe-magnets, preferably electro-magnets energized through conductors 1 2 from any suitable source of electricity. As shown, they are arranged in series, but, if desired, they may be placed in multiple-arc or derived circuits.

The mixture of magnetic and non-magnetic substances enters the upper end of the trough, and is washed down by a stream of water. The mixture may be a magnetic iron-sand, or any combination of magnetic with other materials. When the mixture comes within the influence of the magnet B the magnetic substances therein are attracted and a portion of them are held to the bottom of the sluice, while the rest of the mixture passes on to the next magnet, B′, where the same operation is repeated. A sufficient number of magnets are used to thoroughly separate the substances. In Fig. 2 the magnets are placed under the sluice parallel therewith, and the magnetic substance collects between the poles thereof. The magnets, as seen, may be used to support the sluice, the standards C C being dispensed with.

It is evident that permanent magnets, instead of electro-magnets, may be used, though the latter are preferable. The non-magnetic substance and the water are discharged at the lower end of the sluice, and the magnetic material may be collected in any suitable manner. This construction involves the utmost simplicity and economy, and permits the change of any ordinary sluice-box into a magnetic separator without any cutting or fitting thereof, leaving it in such condition that it may be used, when desired, in any other method—results which, I believe, have not before been attained in this class of devices. Both the sluice-box and the magnets being stationary, the iron particles are held in place and forced to do duty as riffles in the sluice-box.

As stated, in hydraulic gold-mining there will always be found mixed with the auriferous material, sand, &c., a certain amount of magnetic substance. This last, accumulating at the different points *a a* in the sluice beneath which magnets are placed, acts, instead of the usual riffles, to retain the particles of gold, while the sand, &c., flows on to the end of the sluice. The gold and magnetic substance may

then be collected and separated by the process shown in my above-mentioned patent, or in any other suitable manner.

What I claim is—

1. The combination of a stationary sluice box or trough having a solid bottom or feeding-surface and one or more stationary magnets secured beneath the same, substantially as and for the purposes set forth.

2. The method of forming riffles in a mining-sluice, consisting in arresting any magnetic substances which enter the sluice and holding these substances at various points by magnetic attraction, substantially as set forth.

This specification signed and witnessed this 4th day of June, 1881.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

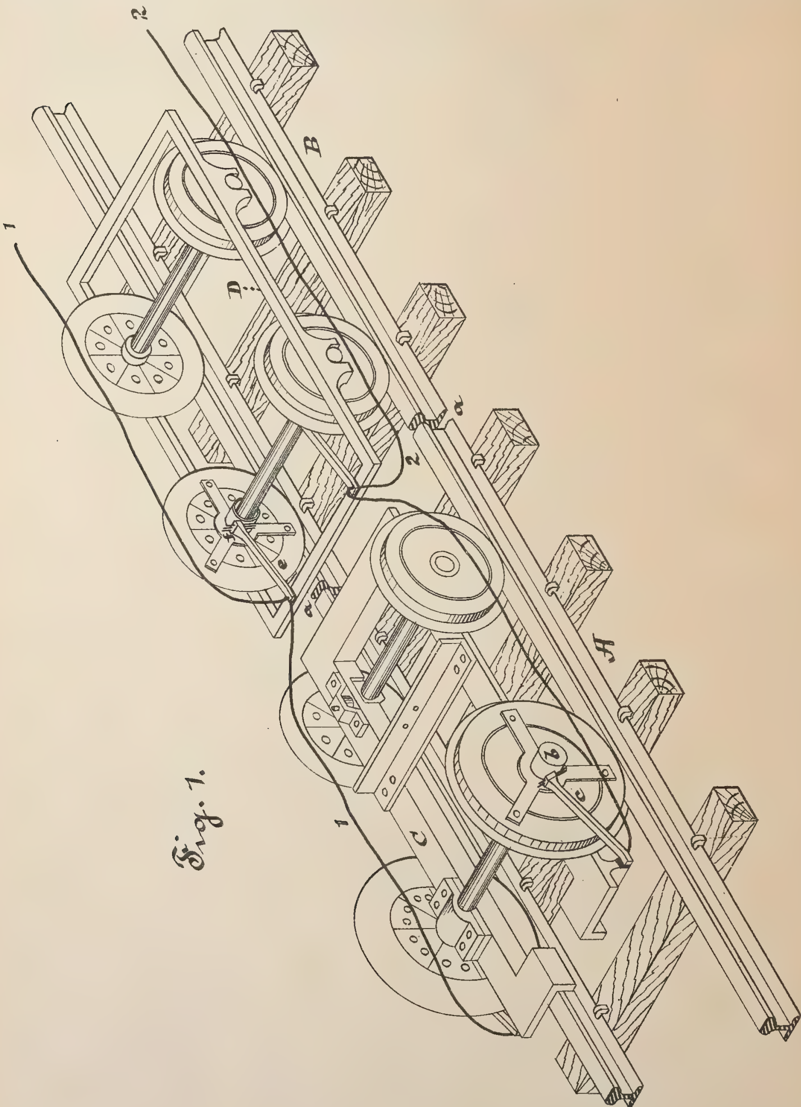
RICHD. N. DYER.

(No Model.) 3 Sheets—Sheet 1.

T. A. EDISON.

ELECTRO MAGNETIC RAILWAY.

No. 263,132. Patented Aug. 22, 1882.



Attest:

O. D. Mott

J. A. Payne

Inventor:

Thos. A. Edison

Attorneys.

N. PETERS. Photo-Lithographer, Washington, D. C.

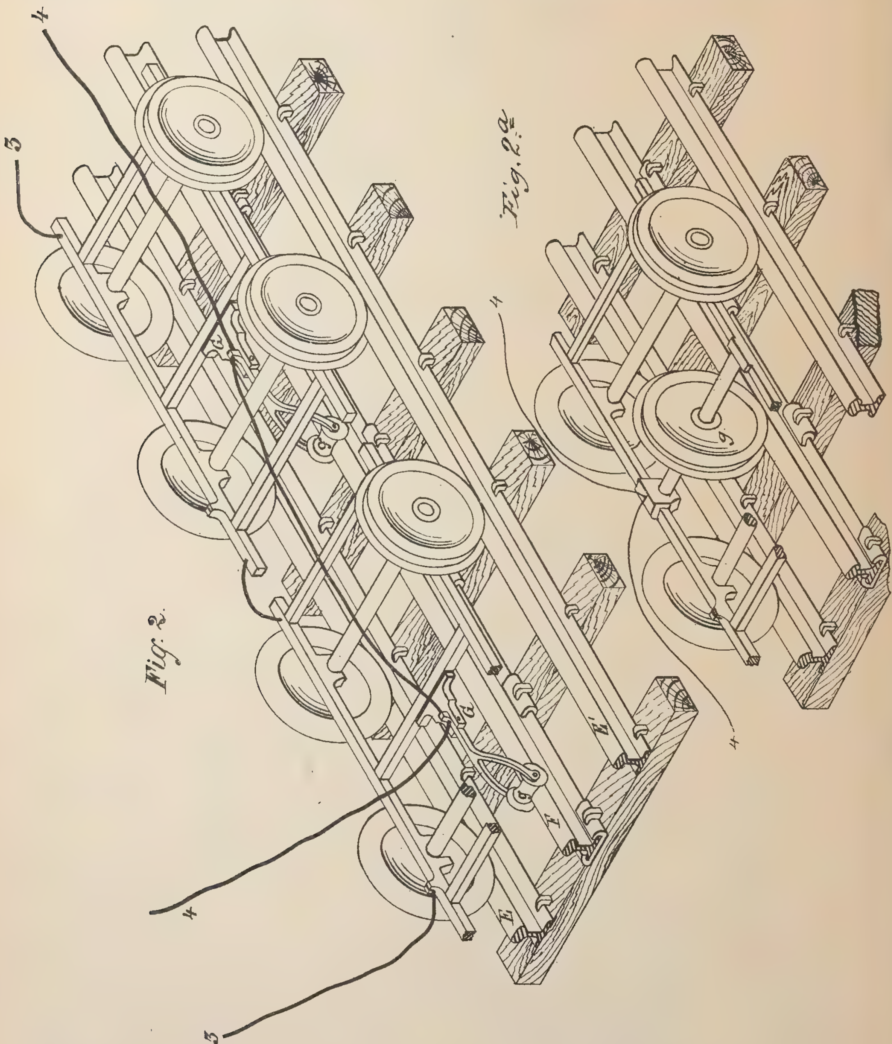
(No Model.)

3 Sheets—Sheet 2.

T. A. EDISON.

ELECTRO MAGNETIC RAILWAY.

No. 263,132. Patented Aug. 22, 1882.



ATTEST:

O. D. Mott

J. A. Payne.

INVENTOR:

Thos. A. Edison

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

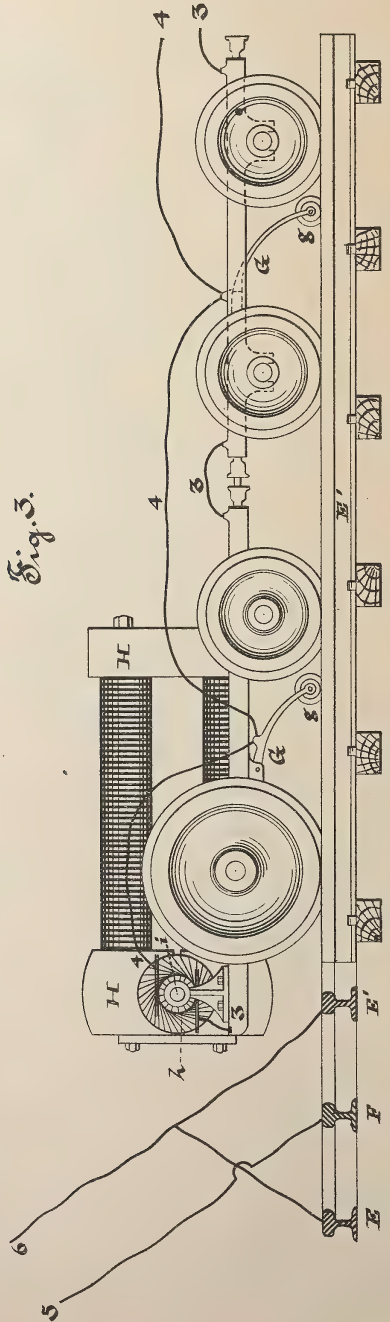
(No Model.) 3 Sheets—Sheet 3.

T. A. EDISON.

ELECTRO MAGNETIC RAILWAY.

No. 263,132. Patented Aug. 22, 1882.

Fig. 3.



Attest:

S. D. Mott

J. A. Payne.

Inventor:

Thos. A. Edison

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRO-MAGNETIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 263,132, dated August 22, 1882.

Application filed August 19, 1880. (No model.) Patented in England September 25, 1880, No. 3,894; in Canada March 31, 1881, No. 12,568; in India May 3, 1881, No. 341; in Victoria May 12, 1881, No. 3,012; in France May 27, 1881, No. 141,752; in New South Wales June 25, 1881; in Queensland June 30, 1881, and in New Zealand August 2, 1881, No. 542.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented certain new and useful Improvements in Electro-Magnetic Railways, (Case No. 329;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In my system of electro-magnetic railways, where the tracks themselves are used as the conductors, it is desirable to make some provision guarding against cessation of effect of the current at crossings, switches, frogs, &c., or other places where it may be desirable to cut out a portion of the track from the circuit. In the introduction of a system of electro-magnetic motive power upon roads already built and equipped for steam-transportation it may be desirable to make the change from one system to the other gradually, in order that the motive-power plant in use may be utilized to the extent of its life. The accomplishment of these ends is the object of this invention.

Referring to the first object, it is to be noted that as a rule the greatest length of track necessary to be cut out of circuit will never exceed the average length of the trains, or even the length of the shortest trains. Hence I prefer to make the electrical connections—bridging over the cut-out section—upon the train itself.

As explained in a prior application, I use in my system the rails as the conductors, and upon the engine or motor car, or, so to speak, the locomotive, wheels having their flanges and hubs insulated from each other, and commutator-brushes arranged to form circuits by means of suitable devices connected to the flanges through the motor from one rail to the other.

I now propose to use such commutator-brushes with the wheels of several of the cars of a train, one of which cars should always be the last one in the train, all the commutator-brushes used on either side of the train being connected by a conductor to the appropriate commutator on the engine, the conductor being so arranged on the cars that they may be readily connected. By this arrangement the cut-out section is electrically bridged over on the train itself, instead of by wires attached directly to the portions of the track in circuit.

In effecting the second object, so as to admit of gradual change, arrangements must be made permitting of the use of both systems. To do this a third or central rail or conductor placed between the others is used, electrically connected in sections of suitable length, and thoroughly insulated from the bed. To the cars are attached arms carrying rollers or auxiliary wheels, taking upon the third rail, and conveying the current therefrom through the motor upon the train, the ordinary rails being used as the return-circuit. These arrangements are shown in the drawings, in which—

Figure 1 is a perspective of the running-gear of two cars, each provided with means for taking the current from the track, the cars being connected together; Fig. 2, a perspective showing the third or central rail and arrangements of circuits on the cars. Fig. 2ª is a perspective showing an extra wheel for use with the third or extra rail; Fig. 3, a side view of an engine and car properly arranged and a cross-section of the three rails with circuit-connections.

In Fig. 1, A and B are two rail-sections, B being an electrically-connected section, while A is cut out from the circuit at *a*, the section A representing a frog, switch, or other place where it is necessary or desirable to cut out electrically a part of the track. C D are the frames of two cars, C being the engine or motor car, the wheels of which are constructed as before described—that is, with the hub and flange insulated from each other—a frame and hub, *b*, insulated from the hub of the wheel, being connected to the flange, a commutator-brush, *c*, taking upon *b* and completing circuit to the engine. Wheels of the same construction are used with the car D, which is the last of the train, any number of cars, all or some of which are similarly constructed, being supposed to intervene between C and D. Preferably the frame and hub upon ordinary cars are upon the inside of the wheels, as shown at *e*

and *f*. Conductors 1 and 2 run the length of the train, connecting all the commutators—1 upon one side and 2 upon the other. It is apparent, then, that when the engine-car has passed upon the cut-out section there will be no cessation of action thereon, as the current will pass from the conducting-section B through the wheels and commutators of car D, by conductors 1 2, to the engine. In the ordinary electrically-connected sections this arrangement has the advantage of making contact with the rails in many places, insuring perfect continuity of circuit, and lessening the spark due to any imperfect contacts consequent upon oxidized spots on the rail.

In Fig. 2, E E′ are the rails of an ordinary railroad, which it is desired to gradually change to an electro-magnetic system. F is a third rail, laid preferably between the ordinary rails, and laid in chairs which thoroughly insulate it from the ties. From the one pole of the generator at the station or source of electricity a conductor, 5, leads to the central rail, F, while a conductor, 6, from the other pole leads to both the rails E E′, as shown in Fig. 3. To the frame of the car, but insulated therefrom, is attached an arm, G, carrying a roller or wheel, *g*, taking upon the extra rail, F. Connected to this arm and wheel is a conductor, 4, which leads to the motor, from which a conductor, 3, completing the circuit therefrom through the iron or metallic parts of the car to the rails E E′, which form the return-circuit. In practice *g* will be an extra wheel, in order to have weight sufficient to always insure good contact even when the extra rail is oxidized, it, by its weight, however, serving to prevent any accumulation of rust, and to keep the surface of the rail bright. In Fig. 2, for convenience of illustration, it is shown as a roller, while in Fig. 2[a] it is shown in the preferred form, an extra wheel upon an axle mounted in bearings insulated from the other wheels by the wooden frame-work of the car.

It is preferable to use an ordinary or common rail for the extra conductor, inasmuch as they are easy to obtain, and as a large mass of conductor with little resistance is given thereby at less cost than to use a copper conductor or one especially prepared for the service.

By using ordinary rails, F, and ordinary wheels, *g*, no special appliances need to be prepared while the change is going on, the method shown demanding in its carrying out only the materials usually employed or easy of obtainment and capable of use for their ordinary functions when their use in this connection is no longer needed. This central or extra rail should be thoroughly insulated from the other rails.

What I claim is—

1. The combination of a series of insulated wheels and commutator-brushes upon different cars, and circuit-connections through all upon each side of the train respectively to the commutator or commutator-brushes of the engine or motor, substantially as set forth.

2. The combination of an extra common or ordinary rail insulated from the others, electrically connected in sections to form one terminal or pole of the source of electricity, and the ordinary or traffic rails, one or both connected in sections to form the other terminal or pole of the source of electricity, substantially as set forth.

This specification signed and witnessed this 14th day of August, 1880.

THOS. A. EDISON.

Witnesses:
WM. CARMAN,
OTTO A. MOSES.

(No Model.)

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 263,133. Patented Aug. 22, 1882.

Fig. 2

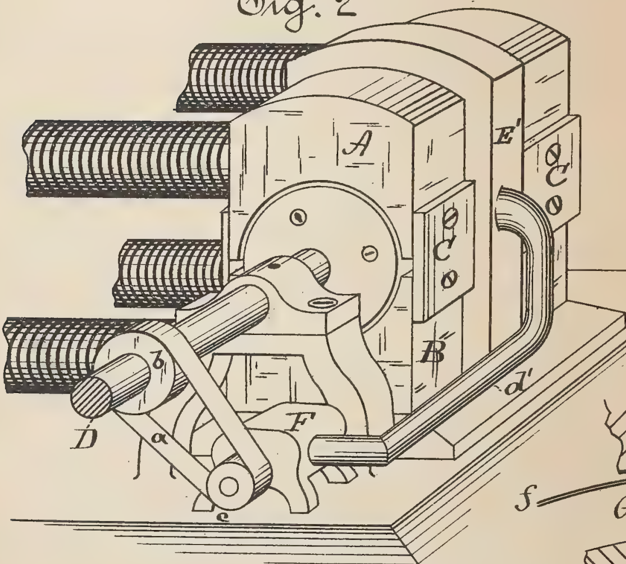


Fig. 3.

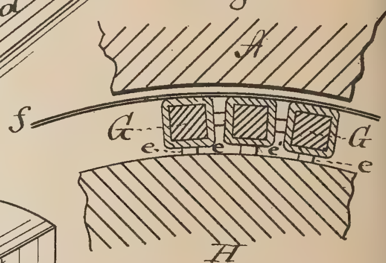
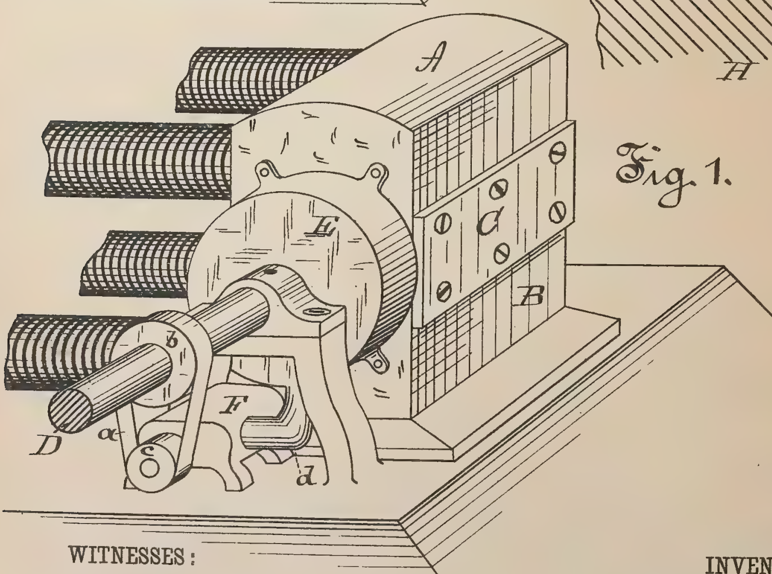


Fig. 1.



WITNESSES:

O. D. Mott.
Wm. J. Clagett.

INVENTOR:

T. A. Edison

BY Dyer & Miller

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 263,133, dated August 22, 1882.

Application filed November 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 346;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce means for cooling the armature of a dynamo or magneto electric machine.

In carrying out my invention I close the spaces between the polar extensions of the exciting magnet or magnets at the sides of the armature by means of brass plates or other non-magnetic metal or material. At the non-commutator end of the machine the shaft is surrounded by an air-chamber, which is a drum having an open side secured to the ends of the polar extensions and covering the ends of the armature, so as to inclose the space between the inductive portion of such armature and the polar extensions. To this air-chamber is connected by pipe the case of an air-blower, which blower is driven preferably by the armature-shaft by means of a belt and pulleys; or the blower may be driven by power from the same source applied in a different manner, or power from any other source. During the operation of the machine the blower is driven and air is forced from end to end of the armature through the space between the same and the polar extensions of the exciting magnet or magnets. By connecting the edges of the polar extensions the space around the armature is closed, except at the ends causing the currents of air to traverse the whole length of the armature. Instead of having the air-chamber at the end of the armature, the polar extensions of the field-magnets may be divided at the center and the space covered by exterior plates. A number of pipes—say three—will lead from the blower to this space, and the air will be forced in both directions from the center toward the ends of the armature. This latter construction has the advantage that there is but one-half the resistance to the passage of the air that there is with the first construction, and consequently with same power four times the amount of air can be forced over the armature. In addition, the air will not be heated to such an extent, and both ends of the armature will have the same temperature.

To allow the currents of air supplied in either way before described to circulate freely around the inductive portion of the armature and between such inductive portion and the core, I have devised the following construction: Instead of using wire coils for the inductive portion of armature, copper bars and cross-connections are employed, the copper bars being preferably wound with suitable insulating and heat-conducting material, as described in an application for patent of even date herewith. These bars are arranged parallel upon the armature-core and spaced a certain distance apart, and are raised off of the core and separated by small blocks or by projections either on the core or bars. The bars are held in this position by their end connections and by being bound at a number of points by wire drawn tightly around the armature. In this manner air-spaces are formed entirely around the inductive bars, through which the currents of air from blower pass. Air-passages are also made longitudinally through the core of the armature, and radial passages extend from the longitudinal passages to the exterior of the core at various points. A portion of the air from the blower is forced through these passages and assists to cool the armature.

The foregoing will be better understood from the drawings, in which Figure 1 is a perspective view of the principal parts of a dynamo or magneto electric machine embodying my invention; Fig. 2, a similar view of a modified form of the cooling devices; and Fig. 3, a cross-section, showing spacing of the copper inductive bars.

A B are the polar extensions of the exciting magnet or magnets, and C the plates for closing the spaces between the side edges of such polar extensions.

D is the armature-shaft.

E is the air chamber or drum inclosing the non-commutator end of armature.

F is the air-blower, driven by belt *a* and pulleys *b c* from armature-shaft D, and having its case connected by pipe *d* with air-chamber E. In the modified form the pipe *d'* of the

blower (or several pipes therefrom) passes to the air-chamber E′, formed by a vertical cut through the center of the polar extensions A B and covering-plates.

G represents the wrapped copper inductive bars, supported off of the armature-core H and separated by blocks or projections *e e′*, and *f* is the wire wrapping for holding bars in place.

What I claim is—

1. The combination, with a dynamo or magneto electric machine, of an air-blower situated outside of the machine and a duct or ducts connecting said air-blower with the space around the armature of said machine, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine, of an air-blower driven by the armature-shaft of such machine, and a duct or ducts connecting said blower with the space between the armature of the machine and the polar extensions of its exciting magnet or magnets, substantially as set forth.

3. In a dynamo or magneto electric machine, the polar extensions of the exciting magnet or magnets connected at their side edges, so as to form a chamber surrounding the armature, and open only at the ends of such armature, in combination with a blower forcing air through said chamber, substantially as set forth.

4. The combination, with the core of the armature of a dynamo or magneto electric machine, of the inductive bars and means for supporting each of said bars, so placed that each bar is separated from the armature-core, a space being left entirely around each bar, substantially as set forth.

5. In a dynamo or magneto electric machine, the combination of the inductive bars supported off of the armature and separated from each other with a blower for forcing air into the space between the armature and the polar extensions of the exciting magnet or magnets, substantially as set forth.

This specification signed and witnessed this 24th day of August, 1881.

THOMAS A. EDISON.

Witnesses:

RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

No. 263,134. Patented Aug. 22, 1882.

Fig. 1.

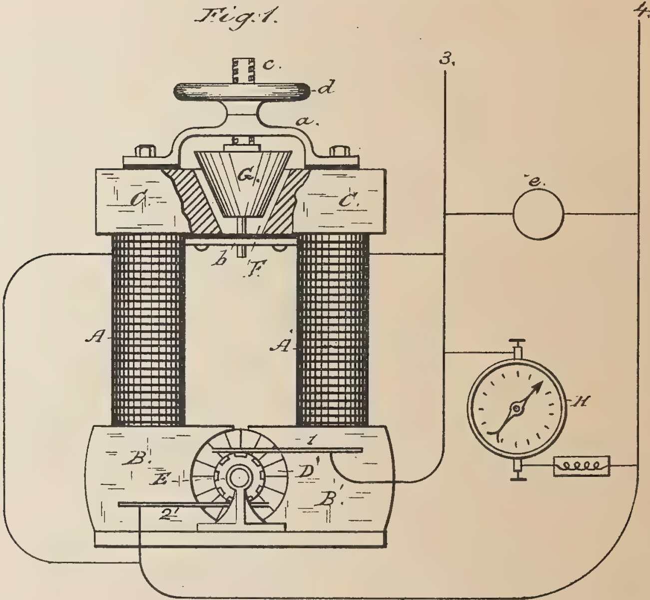
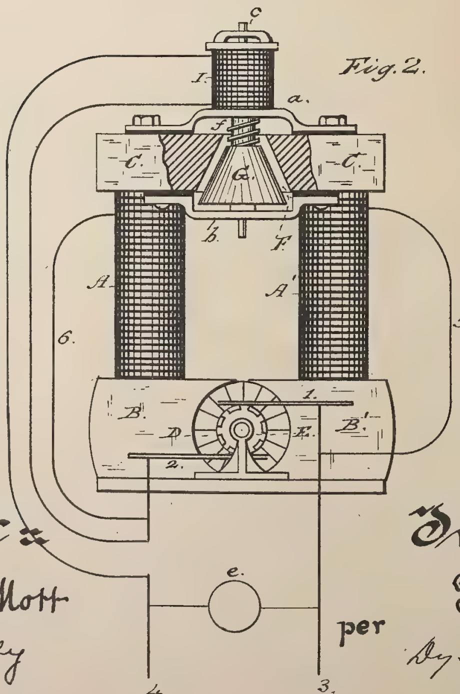


Fig. 2.



Attest:
O. D. Mott
H. W. Seely

Inventor:
T. A. Edison
per Dyer & Wilber
Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 263,134, dated August 22, 1882.

Application filed May 28, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo and Magneto Electric Machines, (Case No. 314;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce simple and efficient means for regulating the generative force of a dynamo or magneto electric machine, so that only the amount of current needed in a circuit may be supplied thereto and the pressure or electro-motive force maintained constant in the circuit. For this purpose I make use of the principle that the power of an electro-magnet can be weakened by diminishing the mass of the yoke connecting the cores, and that such power can be strengthened by increasing the mass of said yoke until the maximum power is attained. In applying this principle I provide the yoke of the field-of-force magnet of a dynamo or magneto electric machine with a movable portion, the position of which can be varied so as to effect the mass and conducting-power of such yoke, said movable portion acting as a magnetic-circuit regulator. This movable portion is preferably situated in the center of the yoke, and is of conical shape, being supported by a spindle which passes through bars connected with the top and bottom of the yoke, and separated therefrom by plates of brass or other non-magnetic material. The position of this movable cone may be adjusted by means of a hand-wheel working on the screw-threaded stem of the cone; or the cone may be drawn into the yoke by an electro-magnet (preferably an axial magnet) the coils of which are in a shunt or derived circuit from the main or consumption circuit, or directly in the main circuit. This magnet forms means for adjusting the cone automatically. Were the yoke entirely cut through, the uniting piece or part varying the mass might become entirely displaced, so that there would be no effect. The construction noted then varies the mass of this yoke only within certain definite limits, the yoke always being complete to a greater or less extent, independent of the position of the movable piece.

In the drawings, Figure 1 is an end elevation of a dynamo or magneto electric machine and connections, with the yoke partly broken away to disclose the magnetic-circuit regulator; and Fig. 2, a similar view, showing the magnetic-circuit regulator operated automatically by the electro-motive force of the main or consumption circuit through an electro-magnet.

Like letters denote corresponding parts in both figures.

A A′ are the helices of the field-of-force magnet; B B′, the pole ends of the same; C, the yoke or bar connecting the helix-cores; D, the revolving armatures of the machine, and E the commutator-block. The commutator brushes or springs 1 2 lead from the block E to the main or consumption circuit 3 4. The field-of-force magnet may be energized by the derived circuit 5 6 or by the main circuit of another generator. The yoke C has a central conical opening, F, passing vertically through it, in which plays the conical block G, forming the magnetic-circuit regulator. This cone is supported by bars *a b*, secured to the yoke, and separated therefrom by brass plates. The stem *c* of the conical block may be screw-threaded and receive above the bar *a* a hand-wheel, *d*, having an internal screw-thread, by turning which hand-wheel the position of the cone with relation to the yoke can be adjusted.

The translating devices represented by *e* are in derived circuits, while an electro-dynamometer, H, is also situated in a circuit derived from the main circuit 3 4, and serves to guide the attendant in his adjustment of the magnetic-circuit regulator. When the electro-motive force increases beyond the desired intensity the attendant retracts the cone, and vice versa, and thereby diminishes or increases the energy of the field-of-force magnet, and consequently the electro-motive force of the current induced in the bobbin of the revolving armature. It is possible, therefore, by these means to maintain a nearly-constant pressure or electro-motive force in the main circuit 3 4.

In Fig. 2 an axial magnet, I, is used to draw the cone into the yoke, the same being retracted by a spring, *f*, and by its own weight. The coil of this magnet is in the main or consumption circuit. When the magnet I is used it is not necessary to employ an electro-dynamometer; but one may be used to check the operation of the magnet.

What I claim is—

1. In a dynamo or magneto electric machine, the yoke of the field-magnet, having an opening through the same, in combination with a block adjustable in and out of said opening, substantially as set forth.

2. In a dynamo or magneto electric machine, the combination, with the yoke of the field-magnet, provided with a conical opening, of a conical block adjustable in and out of said opening, substantially as set forth.

3. In a dynamo or magneto electric machine, the field-of-force magnet, the yoke of which has an adjustable portion acting as a magnetic-circuit regulator, in combination with means operated by the current generated for automatically adjusting said adjustable portion, substantially as set forth.

4. The combination, with the yoke of the field-magnet of a dynamo or magneto electric machine provided with an adjustable portion for regulating the generation of current, of an electro-magnet placed in the main circuit from said machine for adjusting said adjustable portion according to variations in the current required, substantially as set forth.

This specification signed and witnessed this 19th day of May, 1881.

THOMAS A. EDISON.

Witnesses:

RICHD. N. DYER,

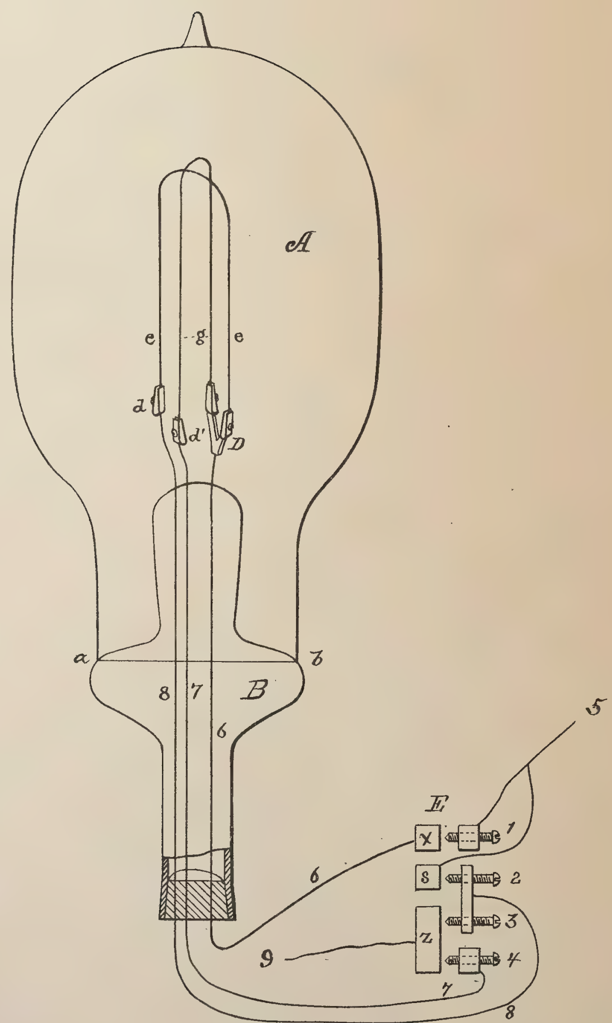
H. W. SEELY.

(No Model.)

T. A. EDISON

ELECTRIC LAMP.

No. 263,135. Patented Aug. 22, 1882.



Witnesses:

S. D. Mott

James A. Payne

Inventor:

T. A. Edison

per Dyer & Wilber

Attorneys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 263,135, dated August 22, 1882.

Application filed August 17, 1880. (No model.) Patented in England September 16, 1880, No. 3,765; in Italy November 6, 1880; in Canada November 11, 1880, No. 11,968; in Belgium November 15, 1880, No. 52,890; in Victoria December 13, 1880, No. 2,936; in Austria January 7, 1881; in Queensland February 7, 1881; in New Zealand March 7, 1881, No. 510; in Portugal March 31, 1881, No. 661; in New South Wales April 2, 1881; in Spain April 26, 1881, and in India July 22, 1881, No. 535.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps, (Case No. 239;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

In the system of electric lighting devised by me I prefer to use an incandescent lamp which shall give a light about equal to a standard gas-jet, say, of eighteen candle-power. In order to insure economy of material in the conductors therefor the incandescing portion is usually of very high resistance. The resistance usually given them is sufficient for any desired economy in ordinarily thickly-settled localities. For use, however, in sparsely-settled neighborhoods—as, say, the outskirts or suburbs of a town or city—it may be desirable to have a lamp by the use of which still greater economy of conductor is attained. In such localities, in order to lessen the number of lights needed in streets, it may be also desirable to have a lamp in which the volume of light is increased, in order that economy in the erection of lamp-posts, &c., may be subserved; and it may also be desirable to use lamps in which the volume of light may be increased in other localities. As there is eventually a limit to the effective life of the carbons used, it seems desirable to so arrange a lamp that the operative life of the lamp may be prolonged beyond the average life of a carbon, to the end that the cost of the labor expended in embodying a carbon in a lamp may be reduced.

The object of this invention is to furnish a lamp which will accomplish the results set forth, as desired, to which end it consists in the features more particularly hereinafter set forth and claimed.

An inclosing-globe is used, made and put together in the usual manner of my lamps. To the inner end of one of the conductors leading into the lamp is fastened a double clamp—that is, one which is Y-shaped, a carbon being fastened to each limb of the Y-clamp. At the other end each carbon is fixed in an individual clamp, each clamp having its own conductor leading outside of the lamp. The wires leading out of the lamp and the wires leading from a suitable source of electricity are united at a circuit-controlling device constructed so that it may close the circuit through either carbon, the circuit through the other remaining open; or it may close the circuit through both, as carbons in a series; or it may close a circuit through each, the circuits through them being derived or multiple-arc circuits.

In the drawing (one figure) such a lamp is illustrated.

A is the glass globe, and B the supporting-neck united at *a b*. Through the neck B passes the conductors 6 7 8, which are sealed therein. Upon the inner terminal of 6 is the Y-shaped clamp D, in each leg of which is fixed a carbon, *e* or *g*. The other ends of these carbons are in separate clamps, *e* being fastened in the clamp *d* of conductor 8 and *g* in clamp *d'* of conductor 7. These conductors, 6, 7, and 8, and the circuit-conductors 5 9, are connected to a key, E, composed of contact-points 1 2 3 4 and anvils *x s z*, as follows: Circuit-conductor 5 is connected to point contacting with *x*, and to anvil *s*, on which 2 contacts, while 9 is connected to anvil *z*, with which both 3 and 4 may make contact. Conductor 6 is connected to anvil *x*, 7 to point 4, which contacts with *z*, and 8 to 2, which contacts with *s*, and to 3, which contacts with *z*. If points 1 and 3 be put in contact with their anvils *x z*, a circuit is formed, from 5, *via* 1 *x* 6 D *e d* 8 3 *z*, to 9, the circuit through *g* being open, and *e* only being used for the production of light. If 1 and 4 be closed on *x* and *z*, the circuit is from 5, *via* 6 D *g d'* 7 4 *z*, to 9, the circuit through *e* being open and *g* alone in circuit and use. If 2 and 4 be closed on *s* and *z*, the circuit is from 5, *via s* 2 8 *e* D *g* 7 4 *z*, to 9, and both *e* and *g* are in one circuit—that is, in series. If 1, 3, and 4 be closed on *x*, *s*, and *z*, the circuit is from

5, *via* 1 x 6, to D, where two paths are found, the current consequently dividing, one circuit being D e 8 3 z, to 9, the other, D g 7 4 z, to 9, both carbons being in circuit, but each having its own circuit, which is a derived one, so far as the main circuit is concerned. When both are used in multiple arc it is evident that the net resistance of the circuit is one-half the resistance of one, and a certain sized conductor is required. If both are used in series, the resistance is double that of one and four times that of the multiple arc, in which case the conductor may be diminished three-fourths. As the volume of light is that of two ordinary lamps, it is evident that a much less number may be used with the same light-giving result. Thus economy in laying main conductors and in the erection of lamps is secured.

It is evident that as one carbon only may be used at a time, by so using one only at a time the life of a manufactured lamp is practically doubled, for where one carbon has reached its effective limit the circuit therethrough is transferred to the other, thus saving the expense involved in sealing one carbon in its globe, the cost of a globe, and of its exhaustion.

It is evident, while only two carbons are shown, that more may be sealed in one globe, D being provided with the same number of clamps, and each carbon provided with a separate return-wire, for which proper connections are made by enlarging key E on the principle shown.

It is also evident that E may be provided with lever-contacts, instead of the screw-contacts used to explain the principle of my invention.

I am aware that it is old to place two or more carbons within one chamber and connect them so that they shall be rendered incandescent simultaneously, and that it is old to place several carbons in one lamp to be used successively. Therefore I do not claim such.

What I claim is—

1. The combination, in one electric lamp, of two or more incandescing conductors, a single electric circuit leading thereto, and a circuit-controller therein, substantially such as described, adapted to connect the incandescing conductors in series or in multiple arc, as may be desired, substantially as set forth.

2. The combination of a single electric circuit, an electric lamp containing two or more incandescing conductors, and means for throwing the current through any desired incandescing conductor independently of the others, substantially as set forth.

3. The combination, in one electric lamp, of two or more incandescing conductors, a single electric circuit leading thereto, and a circuit-controller therein, substantially such as described, adapted to complete circuit through either of the incandescing conductors independently of the others, or through all simultaneously, substantially as set forth.

4. The combination of an incandescent electric lamp containing two conductors arranged as described, the circuit leading thereto and therefrom, the contact-points 1 2 3 4 and anvils x s z, substantially as and for the purposes set forth.

This specification signed and witnessed this 7th day of August, 1880.

THOS. A. EDISON.

Witnesses:

WM. CARMAN,
OTTO A. MOSES.

(No Model.)

3 Sheets—Sheet 1.

T. A. EDISON.

REGULATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

No. 263,136. Patented Aug. 22, 1882.

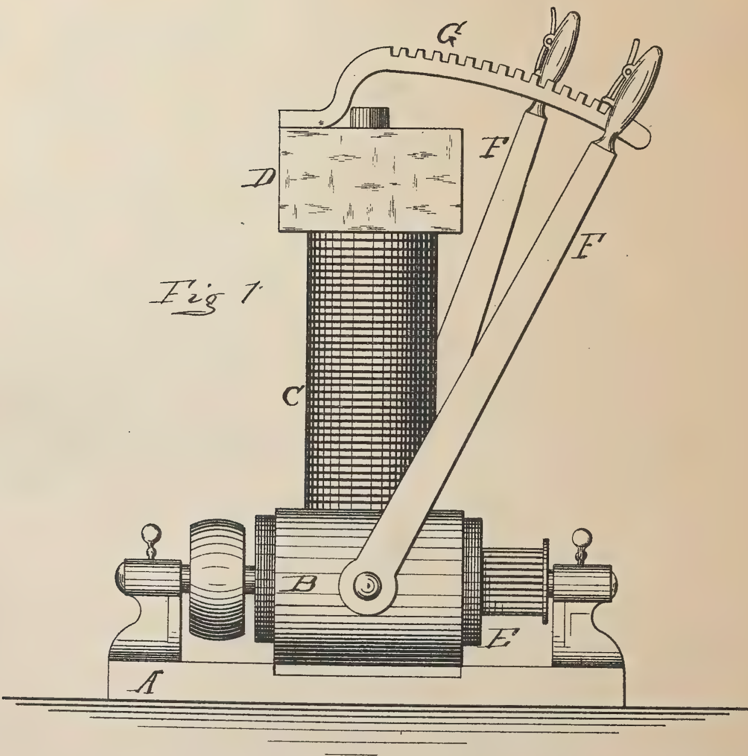


Fig 1.

WITNESSES:

Thomas E. Birch.

Frank H. Hall

INVENTOR:

T. A. Edison

BY Z. F. Wilber

ATTORNEY

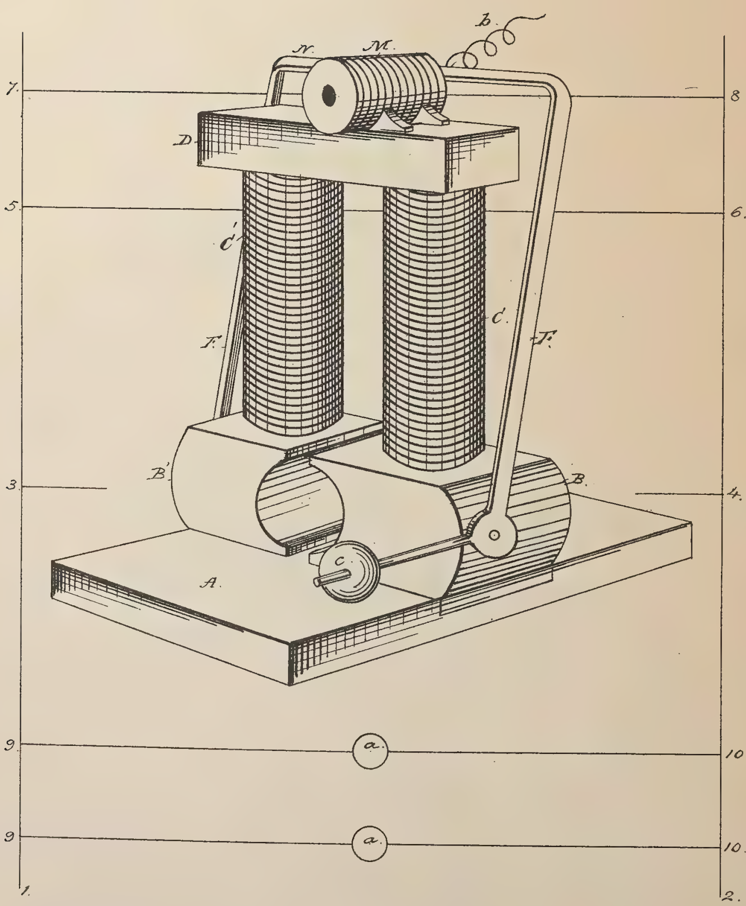
(No Model.) 3 Sheets—Sheet 2.

T. A. EDISON.

REGULATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

No. 263,136. Patented Aug. 22, 1882.

Fig. 2.



Attest,
F. W. Howard
J. H. Hall

Inventor
T. A. Edison per
Z. F. Wilber
atty

N. PETERS, Photo-Lithographer, Washington, D. C.

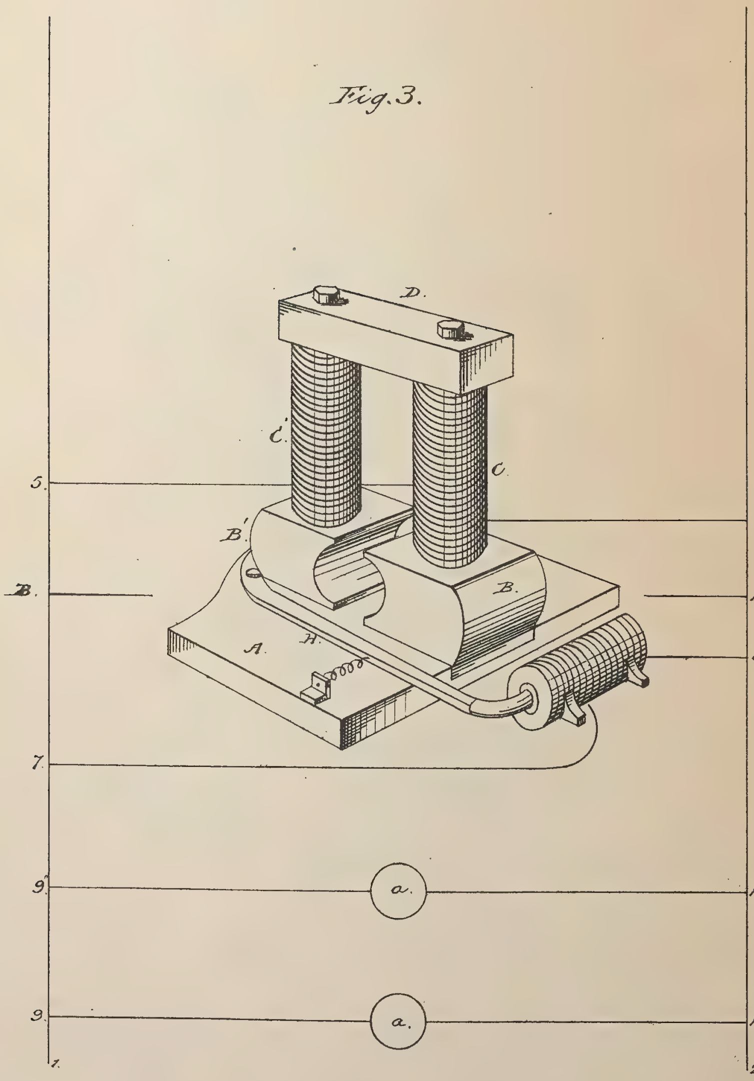
(No Model.) 3 Sheets—Sheet 3.

T. A. EDISON.

REGULATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

No. 263,136. Patented Aug. 22, 1882.

Fig. 3.



Attest;
H. W. Howard
F. H. Hall

Inventor;
T. A. Edison, per
Z. Miller
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 263,136, dated August 22, 1882.

Application filed May 27, 1881. (No model.) Patented in England October 18, 1881, No. 4,552; in Canada November 20, 1881, No. 13,734, and in France December 7, 1881, No. 145,598.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo and Magneto Electric Machines, (Case No. 312;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of my invention is to produce simple and efficient means, operating either automatically or by hand, for regulating the generation of current by a dynamo or magneto electric machine by increasing or diminishing at will the strength of the lines of force in the magnetic field in which the induction-bobbin rotates. This I accomplish by the use of levers or bars of iron adapted to be adjusted close to or farther away from the pole ends and yoke of the magnet or the pole ends alone, which partially shunt the magnetic current or lines of force away from the field in which the armature revolves. These levers or bars I may arrange in either of two ways.

First. I may pivot to the outer sides of the pole ends of the magnet two vertical soft-iron levers rising above the ends of the yoke and making contact with such yoke when in line therewith. The yoke supports two brass segments, which are secured thereto and project some distance off from the same in the line of the play of the shunting-levers. To these segments are connected the said levers by means of suitable latches or clamps, so that such levers, at their upper ends, can be adjusted toward or away from the yoke or brought into contact with the ends of the same.

Second. I may, in place of or in addition to the first construction, pivot upon the base of the machine, close to one of the pole ends of the magnet, one or two horizontal soft-iron levers. The lever used extends across the pole ends of the magnet, being pivoted at one end and adjustable back and forth at the other.

In both constructions the effect of the levers depends upon their mass and their position with relation to the magnet. In the first construction the vertical levers become magnetized, diminishing thereby the strength of the lines of force in the magnetic field, the free end of each lever having a polarity opposite to that of the end of the magnet to which it is attached. Consequent poles are thereby established in the yoke of the magnet opposite the ends of the levers, which poles are increased in power by the approach of the levers to the yoke, from which it will be seen that the lines of force are shunted away from the field in which the induction-bobbin rotates, more or less, according to the distance of the vertical levers from the yoke. In the second construction, supposing one lever only is used, the approach of this lever to the pole ends of the magnet will have the effect of partially bridging or connecting (more or less) the poles of the magnet and shunting the lines of force or magnetic current around or away from the magnetic field. With two levers, one on each side of the magnet, the effect would be increased. The proper size or mass of the levers having been determined to accomplish the effect desired, the adjustment of such levers will diminish or increase the strength of the lines of force in the magnetic field, and in consequence thereof the current generated in the bobbin. Either of these arrangements may be worked automatically by means of an electro-magnetic device actuated by the current generated for moving the levers in the proper direction. For this purpose I use preferably an axial magnet whose core is attached to some portion of the pivoted lever in such way as to move said lever forward or backward according to the degree of magnetization, the arm being provided with a spring or weight to assist its backward motion.

In the drawings, Figure 1 is an elevation of a generator provided with that form of my invention in which the pivoted bars connect the yoke and the polar extensions of the field-magnet; Fig. 2, a perspective view of the same, arranged to operate automatically; Fig. 3, a perspective view of the form in which a pivoted bar crosses the polar extensions of the

field-magnet, this also being so arranged as to operate automatically.

Like letters denote corresponding parts in all three figures.

A is the base of the machine, B B′ the pole ends of the magnet, C C′ the helices, D the yoke, and E the revolving armature, all of which are constructed in any suitable or usual way employed in dynamo or magneto electric machines.

In Fig. 1, F F′ are two vertical soft-iron levers, which are pivoted to the outer sides of the pole ends B B′ of the magnet and rise above the yoke D. Two brass segments, G, are secured to the yoke at opposite ends thereof, (only one being shown,) with which the levers are locked by any suitable means, the segments being shown as toothed and the levers being provided with latches for this purpose.

In Fig. 2 the armature is omitted for convenience of drawing. Main conductors 1 2 are, however, shown.

The derived circuit 3 4 includes the armature, the circuit 5 6 the field-coils, and the circuit 7 8 the coils of the axial magnet M. The movable core of this magnet is attached to the bar N, connecting the levers F F. In derived circuits 9 10 are placed electric lamps, or other translating devices *a a*. When more of these are placed in circuit the current in the derived circuit 7 8 decreases and the magnet M weakens in power. The levers F are then drawn back by means of the spring *b*. Instead of adjusting the spring *b*, a weight, *c*, sliding on an arm projecting from the lever, may be used, so that the force acting against the spring may be readily varied. The levers being drawn back, the magnetic field is strengthened and the generation of current proportionately strengthened. A reverse operation of course occurs as transitory devices are thrown out of circuit.

In the modification shown in Fig. 3 the horizontal soft-iron lever H is pivoted to the base A close to B′, and extends across such base to the other side. A similar lever may be situated upon the opposite sides of the poles, if desired. The shunting effect of these levers, the diminishing thereby of the strength of the lines of force in the magnetic field, and the consequent effect upon the current generated inductively in the bobbin will be understood from the foregoing description. The movement of the levers is automatically accomplished by means of the magnet M, located in the desired circuit 7 8, its movable core being attached to the lever H and the latter being retracted by a spring, *d*. The operation in this case is similar to that described with reference to Fig. 2.

What I claim is—

1. In a dynamo or magneto electric machine, the combination, with the field-magnet, of a bar or lever adapted to magnetically connect the polar and yoke ends of the magnet, being pivoted to or upon one end and adjustable to or from the other end, substantially as set forth.

2. In a dynamo or magneto electric machine, a shunting lever or bar for shunting the lines of force away from or around the magnetic field in which the induction-bobbin rotates, said bar or lever being automatically adjustable to and from the magnet, substantially as set forth.

3. In a dynamo or magneto electric machine, a magnetic shunting lever or bar operating as described, pivoted at one end close to or upon a portion of the magnet and automatically adjustable from the other end to and from another portion of the magnet, substantially as set forth.

4. In a dynamo or magneto electric machine, the combination, with the field-magnet, of a magnetic shunting lever or bar operating as described, and an electro-magnet energized by the current generated for automatically adjusting said lever to and from the magnet, substantially as set forth.

5. In a dynamo or magneto electric machine, a bar or lever adapted to magnetically connect the polar and yoke ends of the field-magnet, being pivoted to or upon one end and adjustable to or from the other end, in combination with an electro-magnet energized by the current generated for automatically accomplishing such adjustment, substantially as set forth.

This specification signed and witnessed this 17th day of May, 1881.

THOMAS A. EDISON.

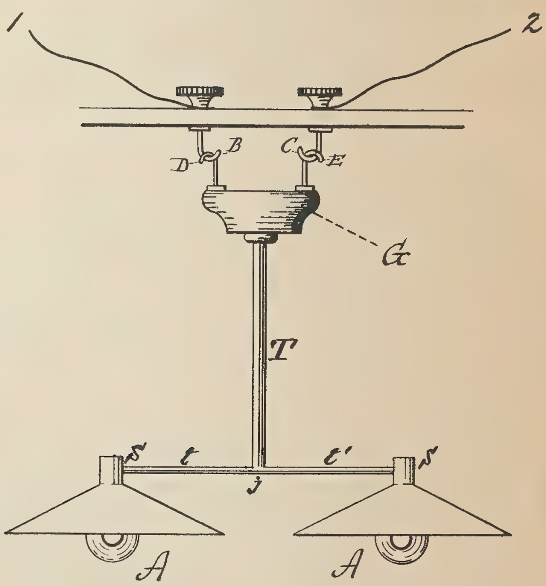
Witnesses:
WM. H. MEADOWCROFT,
H. W. SEELY.

(No Model.)

T. A. EDISON.

ELECTRIC CHANDELIER.

No. 263,137. Patented Aug. 22, 1882.



WITNESSES:

O. D. Mott

M. J. Clagett.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC CHANDELIER.

SPECIFICATION forming part of Letters Patent No. 263,137, dated August 22, 1882.

Application filed August 30, 1881. (No model.) Patented in England September 27, 1881, No. 4,174; in Italy November 9, 1881; in France December 5, 1881, No. 145,554; in Canada December 14, 1881, No. 13,835, and in India January 18, 1882, No. 74.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Chandeliers, (Case No. 321;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

It is often desirable to have an incandescent-electric-light support or chandelier readily removable from one position and readily placeable in another or different position.

The object of this invention is to provide such a support or chandelier, to which end it consists in the features more particularly hereinafter described and claimed. Such a chandelier or support is shown in the drawing.

T is a tube, terminated preferably at its top by a shoulder or enlargement, G, acting as a weight thereto. Within G are secured the two metallic conductors, forming a complete or round metallic circuit when joined to the other devices hereinafter noted. At the upper end of T and G these conductors are formed into or united to hooks D E. As shown, the tube T has two branches, t t', at its lower end, at the outer end of each of which is a lamp-socket, S, holding and supporting an incandescent electric lamp, A. Through each branch t t' branch circuits run, connecting to the socket, as fully set forth in United States Patent No. 251,554.

It is evident that there may be any number of branches t t', or that the support or chandelier may be arranged for only one lamp, the socket being placed directly upon the end j of the tube T.

1 2 are the main conductors, ending, as shown in the drawing, in hooks or eyes B C; but the arrangement of hooks and eyes may of course be varied. Both the sets D E and B C may be hooks, or one may be hooks and the other eyes.

The operation is evident. The chandelier or support being simply hung from B C, a circuit is completed through the chandelier and attached lamps, while the chandelier is readily removable therefrom and attachable to any other place having like provision.

In practice it has been found to be exceedingly convenient to stretch 1 2 as a pair of parallel conductors uninsulated or with insulation removed at desired spots, the chandelier being hung therefrom by the hooks. By this arrangement the light may be readily and easily shifted along the line of work as desired. By this construction and arrangement the conducting-wires are entirely concealed and protected, obviating danger of shock to person or injury to the wires, while a light and portable chandelier is cheaply furnished.

What I claim is—

A hanging incandescent-electric-lamp chandelier or support consisting of a tube in which are secured and protected the conductors placed therein, one or more lamp-sockets attached directly to the tube, or to branch tubes therefrom, and adapted to receive and hold a lamp, and hooks or eyes at the upper end, forming terminals of the conductors placed in the tube and adapted to be suspended from and form contact with the main conductors, or with hooks or eyes connected thereto.

This specification signed and witnessed this 21st day of May, 1881.

THOS. A. EDISON.

Witnesses:

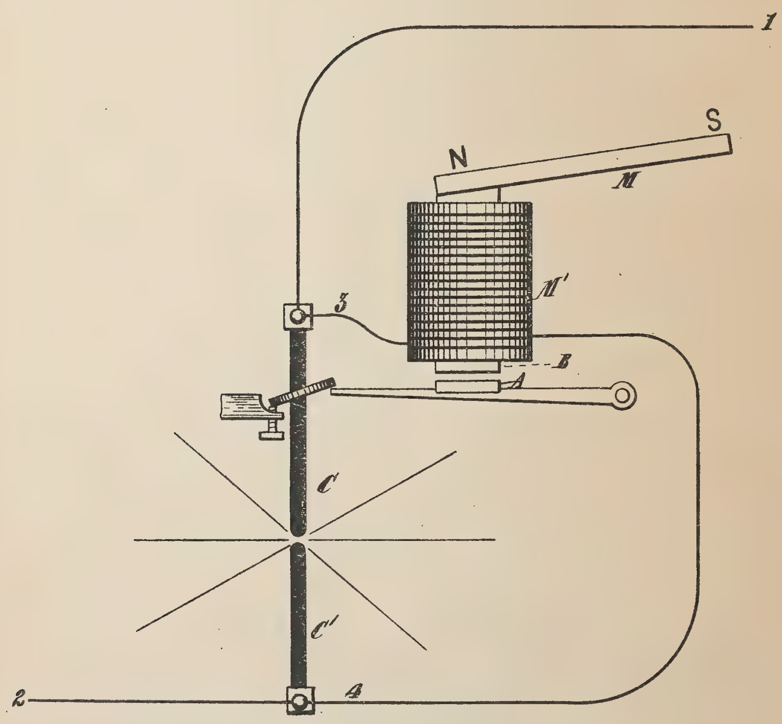
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

ELECTRIC ARC LIGHT.

No. 263,138. Patented Aug. 22, 1882.



WITNESSES:

D. D. Mott

Thomas E. Birch.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC-ARC LIGHT.

SPECIFICATION forming part of Letters Patent No. 263,138, dated August 22, 1882.

Application filed November 28, 1881. (No model.)

To all whom it may concern:

Be it known that I, Thomas A. Edison, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric-Arc Lights, (Case No. 369;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object I have in view is to produce simple and efficient means for controlling the regulating mechanism of arc-lamps. This I accomplish by means of a permanent magnet, which is opposed by an electro-magnet located in a shunt-circuit around the arc. This permanent magnet may be connected with one end of the soft-iron core of the electro-magnet, its action upon such core being opposed to the action of the current flowing through the surrounding coils. The armature acted upon by the magnet is connected in any suitable manner to control the regulating mechanism.

The foregoing will be better understood from the drawing, which shows diagrammatically an arc-lamp embodying my invention.

1 2 represent the line in which are placed carbons C C′.

3 4 represent a shunt-circuit around the arc, in which is placed the electro-magnet M′.

M is the permanent magnet, connected with one end of the soft-iron core B of the electro-magnet. M acts upon B oppositely to the action of the current flowing in the coils of M′.

A is the armature, connected to control the regulating mechanism.

When the lamp is first put in circuit, the carbon points being together, little current passes in the shunt 3 4, and the electro-magnet M′ is but little energized, so that the permanent magnet M acts on the armature-lever A (which is connected with the upper-carbon holder) to raise the upper carbon, C, and establish the voltaic arc; but as the length of the arc is increased by the wearing away of the carbons the resistance of the main circuit becomes greater and more current passes through the shunt 3 4, so that the electro-magnet M′ is energized, and as this is opposed to the permanent magnet M it moves the armature A down and the carbon C down again to the proper distance. The operation is of course continuous after the arc is once established.

What I claim is—

In regulating mechanism for arc-lamps, the combination of a permanent magnet and an electro-magnet opposed in their action, the latter being located in a shunt around the arc, substantially as set forth.

This specification signed and witnessed this 7th day of November, 1881.

THOS. A. EDISON.

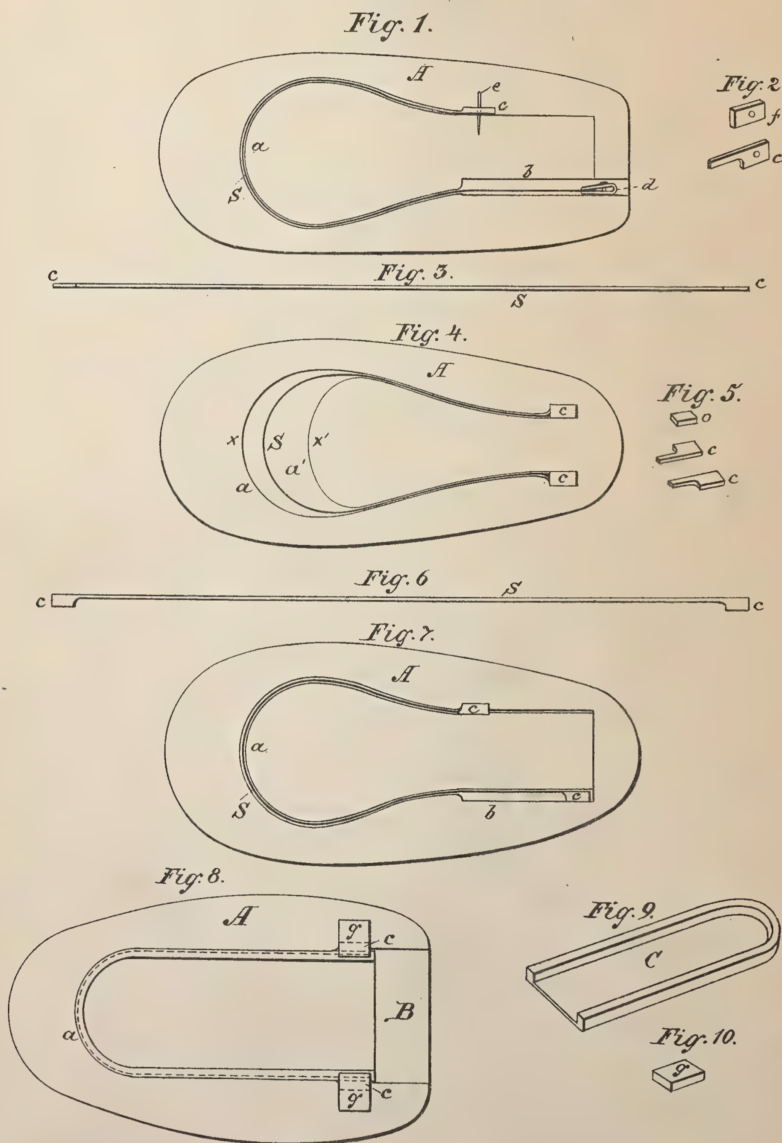
Witnesses:
Richd. N. Dyer,
H. W. Seely.

(No Model.)

T. A. EDISON.

MANUFACTURE OF CARBONS FOR ELECTRIC LAMPS.

No. 263,139. Patented Aug. 22, 1882.



Witnesses.

J. W. Howard

J. K. Hall

Inventor:

T. A. Edison

per Dyer & Wilber

Attorneys.

N. PETERS, Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MANUFACTURE OF CARBONS FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 263,139, dated August 22, 1882.

Application filed August 6, 1880. (No model.) Patented in England September 16, 1880, No. 3,765; in Italy November 6, 1880; in Canada November 11, 1880, No. 11,968; in Belgium November 15, 1880, No. 52,890; in Victoria December 13, 1880, No. 2,936; in Austria-Hungary January 7, 1881; in Queensland February 7, 1881; in New Zealand March 7, 1881, No. 510; in Portugal March 31, 1881, No. 661; in New South Wales April 2, 1881; in Spain April 26, 1881, and in India July 22, 1881, No. 535.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Method of and Means for Manufacturing Carbons for Electric Lamps, (Case No. 230;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

It is desirable in manufacturing carbon slips or filaments of the style generally known as the "horseshoe-carbons," for use as the incandescing conductors in electric lights, that they should be carbonized evenly and uniformly, and that their shape should be preserved, that the carbonization should be effected without warping or twisting the body of the carbon. As, however, the material contracts largely in the process of carbonization, means are required which, while holding the material in position to avoid twisting or warping, shall at the same time guarantee even and thorough carbonization and permit the material to move so that the inevitable contraction during the process may proceed without danger of rupturing or otherwise damaging the carbon.

The object of this invention is to furnish such means; and to that end it consists in the features more particularly hereinafter described and claimed.

In the drawings, Figures 1, 4, 7, and 8 are plan views of carbonizing-plates unitary in principle, but differing slightly in detail. Figs. 3 and 6 are an edge and a side view, respectively, of a slip or filament ready for carbonization. Figs. 2, 5, 9, and 10 are details, more fully hereinafter referred to.

The filament preferably used is one cut or formed from a fibrous material, so that the body is perfectly uniform in size throughout its length, and with enlarged ends, the enlarged ends being upon one edge, or upon one edge and side, as fully set forth in another application of even date herewith, and also illustrated in Figs. 3 and 6.

A is a nickel plate, in which is cut the groove *a*, of the shape desired for the finished carbon, and of a depth sufficient to receive the slip or filament S. The coefficient of contraction of the fiber is determined by experiment, and the length of the groove is made equal to the length desired for the finished carbon plus the contraction of the material during the process of carbonization. In Fig. 1 this extra length is at one end of the groove. *a* is the groove, enlarged at one end into a small chamber just sufficient to receive one of the enlarged ends *c* of the filament, which is secured therein by a pin, *e*. A small wedge, *f*, may also be placed in the chamber to assist in keeping the enlarged end in shape, the pin *e* passing through both *c* and *f*. The other end of the groove *a* is made into a large chamber, *b*, whose length is equal to or greater than the amount of contraction in length of the filament in carbonization. Upon the free end of the slip or filament S the clamp *d* is secured.

The plate A, with the slip or filament secured in position, as described, is covered by a smooth plate; or a series may be used, piled one upon another, the smooth under surface of one forming the cover to the one underneath. They are then placed in a suitable nickel case, and on being subjected to the first low heat carbonization and contraction proceed evenly and equally throughout each slip or filament, the contraction drawing up the loose end in the chamber *b*, until at the conclusion of the process the end *d* is exactly opposite *c*. The cases and plates used are made of nickel, as no other metal stands the high heats necessary in the final stage of carbonization.

In Fig. 4 the groove *a* is shown formed into a chamber, a', at the bow of the horseshoe. In this case the slip S is laid flatwise in the groove, the ends *c c* fitting into chambers at the end of the groove, upon which weights *o* are laid. By this means the ends are held in position during carbonization, while the contraction is from x to x' during the process.

Fig. 7 shows the same construction and method of operation as in Fig. 1, except that while

in Fig. 1 the slip is placed edgewise in the groove in Fig. 7 it is placed flat or sidewise in the groove.

In Fig. 8 the plate A is formed with a chamber in which slides a plate, C, smaller than the chamber by the size of the filament or strip, so that when the plate C is placed in the chamber a groove shall be left, in which is placed the filament or strip, its ends *c c* resting in chambers fitted for them, and held in place therein by weights *g g*, laid thereon in chambers made therefor. As the filament is thus fastened at the ends, as carbonization proceeds the ensuing contraction pulls the bow toward the ends, forcing the plate C toward the end B of A. In all these plans, however, the filament is kept under strain during carbonization, with one or more points fixed against moving, and the contraction proceeds against the strain, which constantly keeps the filament against or in contact with a former, preserving its shape and obviating any risk of warping or twisting. In all provision is made for keeping flat and in their proper relative position the enlarged ends of the carbon.

What I claim is—

1. The method of manufacturing carbons for incandescent electric lamps, uniform and regular in shape and carbonization, consisting in carbonizing filaments while one or both ends are secured in a certain definite position relatively to the amount of contraction, so that when carbonized and contracted the ends shall be in proper position to each other, substantially as set forth.

2. The improvement in the art of manufacturing carbons for incandescent electric lamps, consisting in first shaping the slip or filament therefor from carbonizable material and then carbonizing the same while under constant strain, and with one or both ends fixed, substantially as set forth.

3. The carbonizing-plate provided with a groove for shaping the material, and a chamber or chambers, permitting contraction during carbonization, substantially as set forth.

This specification signed and witnessed this 28th day of July, 1880.

THOS. A. EDISON.

Witnesses:

CHAS. BATCHELOR,

G. E. GOURAUD.

(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 263,140. Patented Aug. 22, 1882.

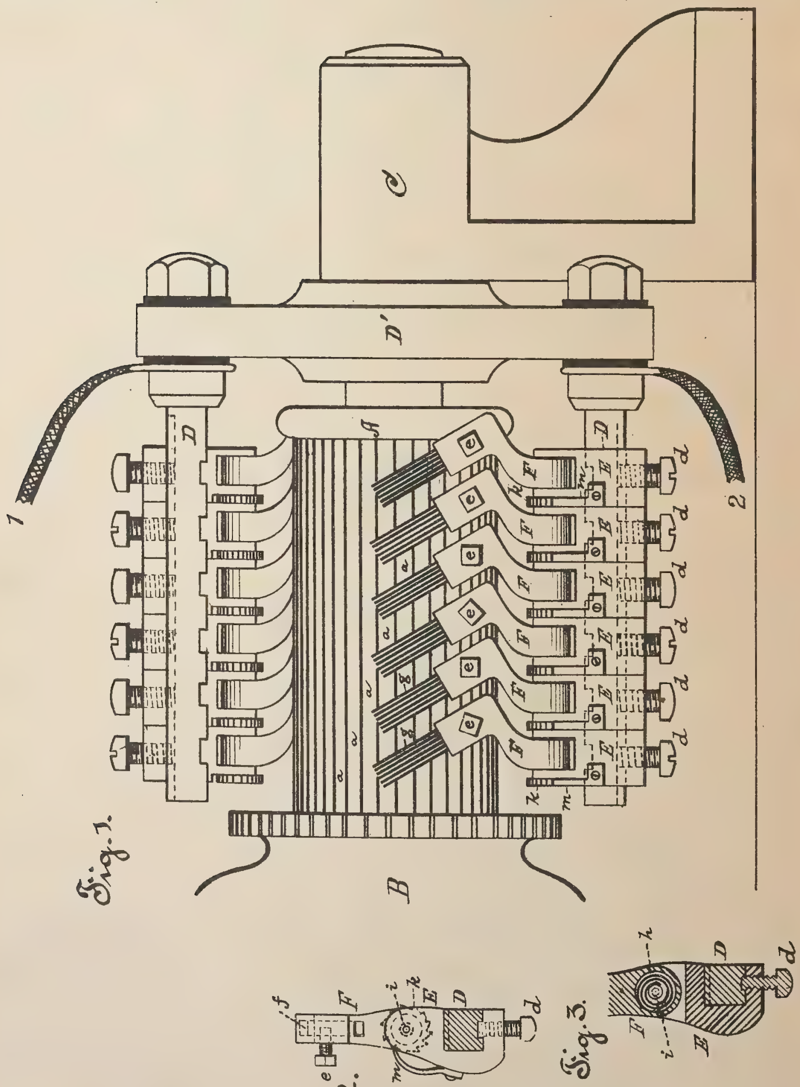


Fig. 1. Fig. 2. Fig. 3.

Attest:

S. D. Mott

E. Berggren

Inventor:

Thos. A. Edison

per Dyer & Wilber

Attys.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 263,140, dated August 22, 1882.

Application filed August 9, 1880. (No model.) Patented in England September 30, 1880, No. 3,964; in Germany February 3, 1881, No. 16,670; in Italy March 29, 1881; in Belgium March 31, 1881, No. 54,152; in Canada March 31, 1881, No. 12,567; in India May 3, 1881, No. 336; in Victoria May 4, 1881, No. 3,005; in France May 27, 1881, No. 141,800; in Spain June 27, 1881; in Queensland June 30, 1881; in New South Wales July 4, 1881; in Austria July 21, 1881; in New Zealand September 15, 1881, No. 551, and in Portugal November 22, 1881.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Magneto or Dynamo Electric Machines, (Case No. 224;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The invention relates to that part of the machine known as the "commutator-brush holder."

As is well known, the commutator-brush generally used consists of a bundle of wires or layers of sheet metal fastened in a frame or brush-holder in such position as to bear upon and make contact with the commutator.

As hitherto constructed the brush-holders have usually been rigidly attached to the frame of the machine with some device for adjusting them to different positions with relation to the commutator, and also so attached that if a commutator-brush became so damaged as to need repairs or replacement a stoppage of the machine was necessitated.

It is important that the pressure of the brushes upon the periphery of the commutator should be constant and capable of adjustment to the desired degree, as when the pressure is too great the parts are too rapidly abraded and worn away, and when too slight an arc may form between the opposed surfaces or portions thereof, causing them to be burned or oxidized.

It is also important that provision should be made permitting the removal for repair or replacement of a brush without stoppage of the machine or interference with its capacity or the current transmitted.

The accomplishment of these results is the object of this invention; and to that end it consists in the features more particularly hereinafter set forth and claimed.

In the drawings, Figure 1 is a view of a commutator and series of commutator-brushes embodying the invention; and Fig. 2 is a side view of one brush-holder, and Fig. 3 a longitudinal section of part of one brush-holder.

A is the commutator of a dynamo or magneto electric machine, placed, as usual, at the end of the rotating armature B, and supported at its outer end in bearings C, *a a* being the strips thereof connected to the coils of the armature, but insulated from each other.

At a suitable distance from the commutator square bars D D are supported in (but insulated from) supports D′ D″, one of which only is shown.

The brush-holders are made in two pieces, E F, the part E being formed with a U-shaped recess or jaw at its upper end, in which takes and in which is pivoted the part F. A pin or pivot, *i*, passes through the two parts and holds them together. In the lower portion of the part F a chamber is formed, in which is placed the spring *h*, whose inner end is attached to *i*, the outer end being fast to the wall of the chamber. Upon the end of *i*, outside of the chamber, is a ratchet-wheel, *k*, a part, *m*, being arranged upon E to take into the teeth of *k* and hold it in a fixed position. In the upper or free end of F is a chamber or recess, *f*, for receiving and holding a brush, which is secured therein by a set-screw, *e*. Upon the inner side of E is cut a groove the size of the bar D, in the under side of which is cut a slot, as shown in Figs. 2 and 3. A series of commutator-brush holders thus constructed are placed side by side upon the bars D D by simply slipping each onto the bar from the front, each being secured thereon by the set-screw *d* taking into the groove on D. The use of a series, as shown, involves several advantages. Each series of brushes is in metallic contact at the same time with the same strip or strips of the commutator; hence sparks between the commutator and brushes are greatly lessened, if not entirely obviated, and a large current can be conveniently taken from the machine with very little, if any, resistance thereto in the commutator. From these re-

sults I have applied the name "large-current multiple brushes" to this arrangement of brushes.

If repairs upon or replacement of one or more brushes be necessary, the set-screws *d* of the defective brushes are loosened and the holder of such defective brushes removed from the bar D without disturbance of the remaining brushes, which afford ample contact-surface.

As before stated, the ratchet *k* is upon the pivot *i*, to which is attached the spring *h*. Hence by turning the ratchet *k* any desired degree of resilience may be given the spring, which force is expended in holding the brush upon the commutator with a steady and uniform pressure, which may be varied or regulated by means of the ratchet.

What I claim is—

1. In a dynamo or magneto electric machine, the combination, with the commutator, of two series of brushes, (one upon each side,) each brush of a series being mounted independently upon a supporting shaft or bar common to all of its series, and provided with means within itself for adjustment of pressure independently of all the others of the series, substantially as set forth.

2. The combination, with a commutator, of a series of brushes and holders, each mounted independently upon a bar or shaft and arranged so that each brush takes obliquely upon the commutator, substantially as set forth.

3. A brush-holder formed of two parts, the one for fixed seating upon a proper support, the other connected thereto by an adjustable spring union, substantially as set forth.

4. In a dynamo or magneto electric machine, the combination of a bar for supporting the brushes, grooved upon one of its faces, and the brush-holder provided with a screw adapted to take in said groove, substantially as set forth.

5. A brush-holder having its end receiving the brush formed at an angle to its body, so that the brush may take obliquely upon the commutator, substantially as set forth.

This specification signed and witnessed this 30th day of July, 1880.

THOS. A. EDISON.

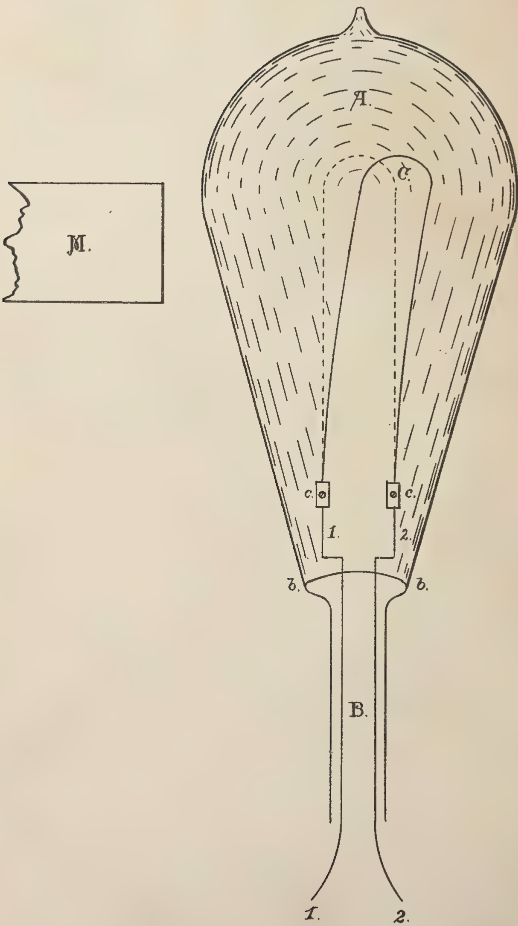
Witnesses:
WM. CARMAN,
S. L. GRIFFIN.

(No Model.)

T. A. EDISON.

STRAIGHTENING CARBONS OF ELECTRIC INCANDESCENT LAMPS.

No. 263,141. Patented Aug. 22, 1882.



T. A. Edison

INVENTOR;

per Dyer & Melvin
Attys

ATTEST;

J. E. Clark.

H. W. Seward

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

STRAIGHTENING CARBONS OF ELECTRIC INCANDESCENT LAMPS.

SPECIFICATION forming part of Letters Patent No. 263,141, dated August 22, 1882.

Application filed June 24, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Straightening Carbons of Electric Incandescent Lamps, (Case No. 320;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

It sometimes happens in the manufacture of the carbon filaments used in incandescent electric lamps, or in the manipulation attendant upon their embodiment in lamps, that they become distorted or crooked, leaning to one side, instead of standing straight within the glass inclosing globe.

The object of this invention is to provide a method of straightening the carbon filament when it has become so bent or distorted. To accomplish this the carbon filament to be straightened, after its embodiment in a lamp, permanent or temporary, is raised to a high degree of incandescence by the electric current. It is preferable that the degree to which it is raised should be somewhat higher than that at which it is intended to use it thereafter. While thus heated the carbon filament is subjected to the action of a magnet placed in close proximity thereto upon the exterior of the glass inclosing globe or chamber. The attraction of the magnet will cause the filament to gradually become straight. When this has been attained the circuit through the carbon is broken and it is allowed to cool. While cooling it is preferable that it remain under the action of the magnet to prevent any electrical carrying during the short time the carbon is still hot after the current has ceased to act, during which period carrying is still likely to occur. After such cooling it will remain straight, especially if used at a lower degree of incandescence than that used during the straightening process.

In the drawing, A represents the glass inclosing globe of an incandescent electric lamp whose carbon filament C is bent or distorted, as shown. As here shown, the lamp is a permanent one, the filament C being secured by clamps *c c* to the terminals of leading-in wires 1 2, which are sealed into the glass tube B, hermetically sealed to the globe A at *b b*. It is evident, however, that the lamp might be a temporary one, used simply for the purpose of the process. The filament C is raised to a high degree of incandescence by connecting 1 2 to a suitable source of electricity. When rendered incandescent the magnet M is brought into close proximity thereto, causing the filament to gradually straighten, as indicated in dotted lines. When straightened sufficiently the circuit through 1 2 is broken and the filament allowed to cool, preferably while under the influence of the magnet M.

What I claim is—

1. The method of straightening a bent or distorted carbon filament in an incandescing electric lamp, consisting in electrically heating the same to a high degree of incandescence, then subjecting the heated filament to the action of a magnet, and then allowing it to cool while still under the influence of the magnet, substantially as set forth.

2. The method of straightening a bent or distorted carbon, consisting in electrically heating the same to a high degree of incandescence and subjecting it to the action of a magnet while so heated, substantially as set forth.

This specification signed and witnessed this 21st day of May, 1881.

THOS. A. EDISON.

Witnesses:

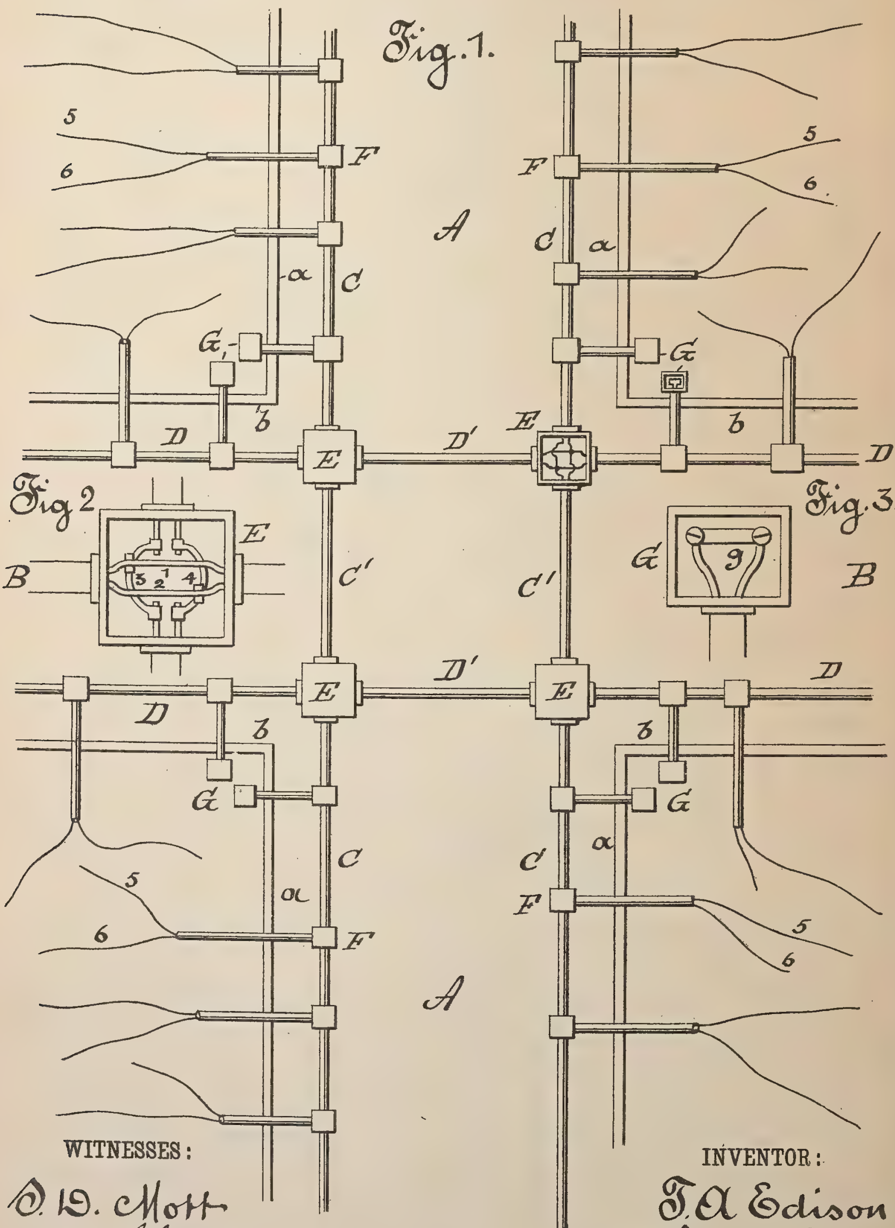
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

ELECTRICAL DISTRIBUTION SYSTEM.

No. 263,142. Patented Aug. 22, 1882.



WITNESSES:

O. W. Mott

M. J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRICAL DISTRIBUTION SYSTEM.

SPECIFICATION forming part of Letters Patent No. 263,142, dated August 22, 1882.

Application filed October 4, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Distribution Systems, (Case No. 343;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of my invention is to produce such an improvement upon systems for the distribution of electricity for translation into sensible effect—such as light, power, or heat—that an accidental cross between the main wires at any point will only affect the house-circuits upon the side or face of the block where the cross occurs.

In laying the conductors for my system I run along each side or face of a block two conductors. These I term "positive" and "negative" conductors, the positive conductor being the one through which the positive current flows to the lamps or motors, while the negative conductor returns the current to the feeding-circuit, and thence through the negative feeding-conductor back to the generators. In front of each house, or at any other point where it is desired to make connection with the main conductors, they are run into a service-box, which is a square iron box, in which the conductors are laid bare for connection with the house-wires. At each corner of a block is a junction-box, into which the conductors on the meeting sides of the block pass, and also conductors which cross the streets from the opposite junction-boxes. Thus at the intersection of two streets will be placed four junction-boxes, into each of which will run eight main conductors. In each of such junction-boxes all the positive conductors are connected together, and likewise all the negative conductors, so that a net-work of intersecting wires is formed. On each face of a block, anywhere between the points of intersection of the main conductors in the corner junction-boxes, the conductors are run through a small junction-box; or one of them only may pass through the same. In this box one conductor is severed and its ends connected to conductors leading to a safety-catch box located at some point where it can be conveniently reached to replace the safety-catch wire when necessary; or both conductors may run through this box and be provided with safety-catches. In this box the requisite amount of safety-catch wire or material is placed in circuit, and is burned out when a cross on the main conductors occurs on the particular side of the block where the box is located, thus breaking the circuit and preventing damage. By placing safety-catches in this manner in the main conductors on each face or side of a block the accidental cross-connection can be readily located, and by connecting all the main conductors of each class together at the corners only the translating devices on the particular side of the particular block are affected by the breaking of the circuit.

The foregoing will be better understood from the drawings, in which Figure 1 is a top view of the conductors at the intersection of two streets, the covers of a corner junction-box and a safety-catch box being removed; Fig. 2, a separate view of a corner junction-box with the cover removed, and Fig. 3 a similar view of a safety-catch box.

Like letters denote corresponding parts in all three figures.

A and B are two intersecting streets, and *a b* the curb.

C D are the tubes or pipes inclosing the conductors. These tubes or pipes run along the faces of the blocks, and enter the corner junction-boxes E, while similar tubes, C′ D′, placed in line with C D cross the streets and connect the junction-boxes. Each of these tubes carries two main conductors in the manner described and shown in an application for patent already filed by me, (Serial No. 31,825;) or the conductors may be inclosed in separate pipes, as set forth in an application of even date herewith.

The house-service boxes are shown at F, and from these are led the house wires or conductors 5 6.

E E show the corner junction-boxes, in which the four conductors intersect, like conductors being electrically connected. The use of such

boxes enables the points of union to be readily reached, so that disconnection may be easily made when desired. The preferable form of connection across the box of the conductors forming a continuous line is by bow-shaped conductors, as shown in Fig. 2, as thereby provision is made for contraction or expansion due to varying temperature, such effects being ultimately conveyed to the bow-shaped conductors, which absorb them without risk of breaking the continuity of the electric circuit.

G represents the safety-catch boxes, one being situated on the face of each block, as before explained, and having a piece of safety-catch wire, *g*, placed in the line of one or each of the main conductors. These safety-catch boxes are preferably located inside of the curb, and are arranged so that they can be readily reached to replace the safety-catch wire. This arrangement of the safety-catches protects the entire system from the effects of malicious or accidental crossing or short-circuiting, except of course at the immediate vicinity of the crossing or short-circuiting. If on the face of either block the main conductors should be so connected as to short-circuit the lamps, the safety-catches on either side would be immediately burned out, a short section, not over the face of a block, be cut out, while the remainder of the system would be uninjured and unaffected.

What I claim is—

1. In a system of electrical distribution employing complete metallic circuits, the combination of the positive conductors and the negative conductors crossing each other at the corners of the blocks, like conductors being connected together at the points of crossing, and service or junction boxes wherein such connection is made, substantially as set forth.

2. In a system of electrical distribution, the combination, with the intersecting positive and the intersecting negative conductors connected together in pairs, as described, of the safety-catches between the points of intersection, substantially as set forth.

3. In a system of electrical distribution, the combination, with the main conductors arranged in pairs, intersecting each other and properly connected together at corners or branching points, of safety-catches placed at the points of intersection in boxes adapted to protect them and receive the ends of the conductors for union thereto, substantially as set forth.

4. The combination, with the conductors and the junction-boxes wherein the appropriate conductors are united to each other, of the bow-shaped connecting-pieces, substantially as set forth.

This specification signed and witnessed this 24th day of August, 1881.

THOMAS A. EDISON.

Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

MAGNETO OR DYNAMO ELECTRIC MACHINE.

No. 263,143. Patented Aug. 22, 1882.

Fig. 1.

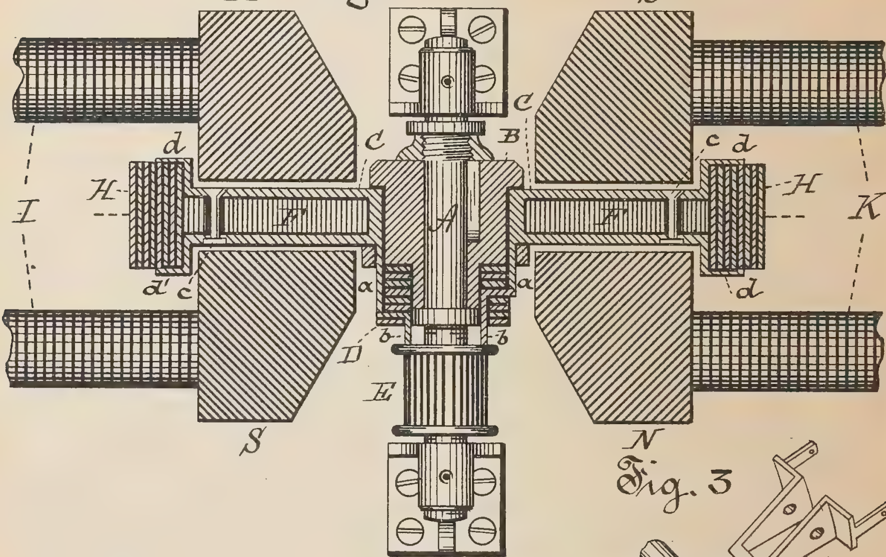


Fig. 3

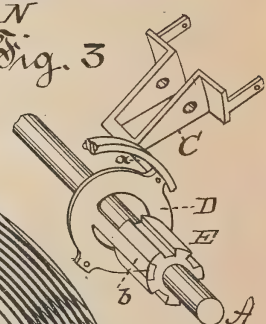
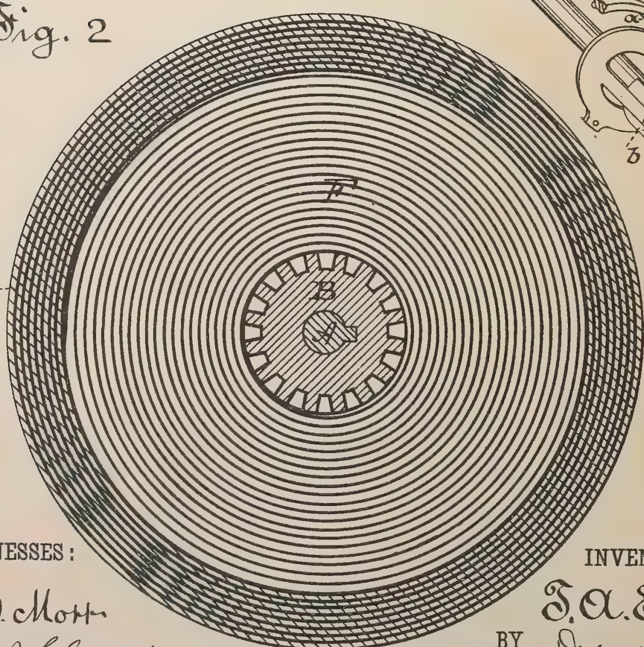


Fig. 2



WITNESSES:

O. D. Mott

Wm. J. Clagett.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

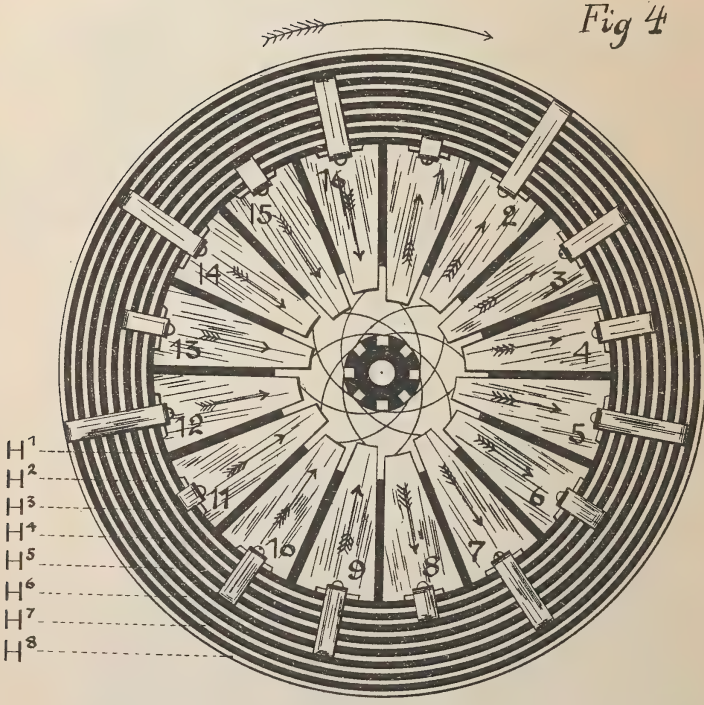
(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

MAGNETO OR DYNAMO ELECTRIC MACHINE.

No. 263,143. Patented Aug. 22, 1882.

Fig 4



WITNESSES:

O. D. Mott

F. H. Hall

INVENTOR:

T. A. Edison

BY L. F. Milbar

ATTORNEYS.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MAGNETO OR DYNAMO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 263,143, dated August 22, 1882.

Application filed August 30, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Magneto or Dynamo Electric Machines or Electric Engines, (Case No. 334;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce a dynamo or magneto electric machine the armature of which will be in the form of a disk, which armature will be stiff and strong, will not heat in its core in use, will permit the bringing of the polar extensions of the magnet or magnets close together, so as to form an intense magnetic field, and in which machine the inductive bars of the armature will be connected to generate a continuous current in one direction of high electro-motive force, and will further be connected with the commutator-bars and with each other in multiple arc in order to reduce to the minimum the internal resistance of the machine.

In carrying out my invention I make the naked copper inductive bars double or in two parts, connected together at their inner ends, and having offset-arms at their outer ends for connecting with the surrounding concentric rings. A number of these double radial bars are arranged in the form of a disk and secured to a suitable hub, the bars being insulated both from the hub and from each other. At their inner ends the double bars are connected to insulated metal disks, (the nearly-opposite double bars being connected in pairs by the disks,) and the disks have tongues which make connection with or form the bars of the commutator-cylinder. The core of the armature is constructed by winding strips of iron and paper together, in spiral form, between such double bars, such core preventing the circulation of magnetic currents therein and the loss of energy caused by the generation of heat in such core. The effect is assisted by the fact that the iron portion of the core does not cut the lines of force at right angles. The polar extensions of two electro-magnets are arranged on each side of the disk-armature. Outside of the polar extensions the terminal double bar of each connected pair of double bars is connected with the initial double bar of another pair by concentric rings which are nearly outside the magnetic field and do not cut the lines of force at right angles.

The construction is also well adapted for electro-motors, and, whether as a motor or electrical generator, it has the advantage of great lateral compactness.

In the drawings, Figure 1 is a horizontal section of the machine, the commutator brushes or springs being omitted, and the magnets being broken away; Fig. 2, a vertical section of the armature; Fig. 3, a separate perspective view of one of the double inductive bars and its commutator-connection, and Fig. 4 a side elevation of the armature.

A is the shaft journaled in suitable bearings.

B is the hub suitably secured to the shaft, and having attached to it the double inductive bars C, of naked copper. These bars are connected at their inner ends, and are insulated from the hub and from each other. The bars C have projecting conductors a extending to insulated metal disks D. The bars C are connected in pairs with the bars nearest a diametrically-opposite position, and each disk has a tongue, b, which is connected with or forms one of the bars of the commutator-cylinder E. For ease of illustration only two of such tongues are shown in Fig. 1. The core F of the armature is made by winding spirally together strips of iron and paper. Bolts c may be employed to assist in securing the bars and core together. The double bars C have offset-arms d for making connection with the concentric rings H, which surround the core. Each ring connects the terminal bar of one pair of connected opposite double bars with the initial bar of another pair. Hence there are half as many rings as bars. The polar extensions N S of the electro-magnets I K are brought close up to the inductive bars.

I do not claim in this application the beveled polar extensions shown in Fig. 1, for the reason that I intend to make separate application for Letters Patent thereon.

The bars are connected in the same manner

as described in an application for patent already filed by me on an electrical generator or engine having a coreless disk-armature divided into radial sections, the path of the current being as follows—see Fig. 4: one portion of the current will pass from the negative to the positive commutator-brush *via* 1, H′, 11, 2, H^8, 12, 5, H^7, 14, 7, H^6, and 16, and the other portion *via* 8, H^2, 15, 6, H^3, 13, 4, H^4, 10, 3, H^5, and 9.

What I claim is—

1. A dynamo or magneto electric machine or electric engine having an armature of disk form, constructed of a core, upon which are secured radiating copper inductive bars, with concentric rings, for making the external connections between said bars, substantially as set forth.

2. A dynamo or magneto electric machine or electric engine having a disk-armature constructed of an iron core and radial copper inductive bars, said inductive bars being connected in pairs together, and with the commutator-bars at their inner ends, and the terminal and initial inductive bars of the pairs being connected at their outer ends so as to form a closed circuit, substantially as set forth.

3. In a dynamo or magneto electric machine or electric engine, the combination of the disk-armature core, the double radial copper bars connected in pairs together, and with the commutator-bars at their inner ends, and the concentric rings for connecting the terminal and initial bars of the pairs at their outer ends, substantially as set forth.

4. In a dynamo or magneto electric machine or electric engine, the disk-armature core composed of spirally-wound strips of metal and insulating material, substantially as set forth.

This specification signed and witnessed this 24th day of June, 1881.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,

WM. H. MEADOWCROFT.

(No Model.)

T. A. EDISON.

MOLD FOR CARBONIZING INCANDESCENTS.

No. 263,144. Patented Aug. 22, 1882.

Fig. 1.

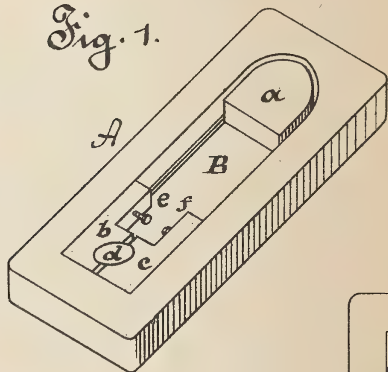


Fig. 2.

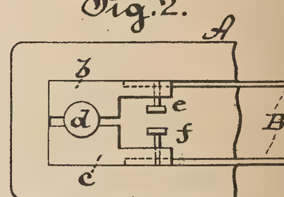
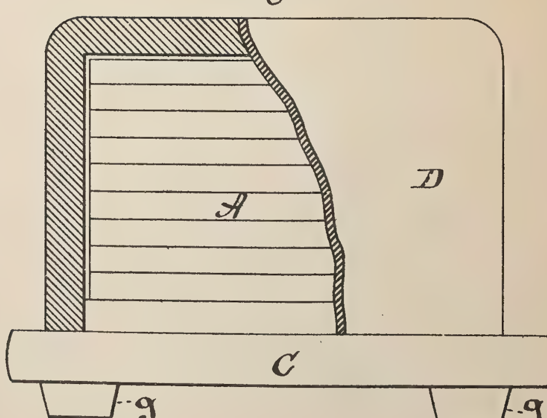


Fig. 3.



WITNESSES:

D. D. Mott

Wm J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MOLD FOR CARBONIZING INCANDESCENTS.

SPECIFICATION forming part of Letters Patent No. 263,144, dated August 22, 1882.

Application filed November 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Molds for Carbonizing Filaments or Slips, (Case No. 349;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce a mold for carbonizing the incandescing carbon conductors or loops of my electric lamps, which will be capable of withstanding the high heat to which it is necessary to raise the conductors or loops in the process of carbonizing, will not affect the carbon conductors injuriously, and will be durable in use and cheap in manufacture; and, further, to provide method and means for keeping the conductors under proper strain while being carbonized, and insure the equal contraction of both limbs of each carbon loop, so as to overcome as fast as possible the loss caused by the unequal contraction of such limbs.

In carrying out the first part of my invention, I employ pure plumbago, which is subjected to hydraulic or other heavy pressure in perfectly-shaped dies or molds. These forming-molds give to the carbonizing-molds the form desired. By making the carbonizing-molds of pure plumbago great durability and cheapness are obtained. The pure plumbago, also, does not affect the carbon filaments injuriously when raised to a white heat. The crucible mixtures of plumbago and clay could not be used for this purpose, since the clay would be reduced, and the oxygen thrown off by the same would combine with the carbon of the incandescing conductors and affect the same injuriously. A mold of crucible mixture would also crumble to pieces within a limited time, and would not be nearly as durable as the mold of plumbago. I may add to the plumbago in the manufacture of the carbonizing-molds a small proportion of gum-dextrine or other carbonizable gluten which will combine with the plumbago at a high heat and lock the particles of the plumbago together, this glutinous substance not acting upon the filaments during carbonization.

The second part of the invention is carried out by holding the looped filament at its center and allowing the limbs to contract while under strain. For this purpose the mold is provided with a stationary block, forming, with the side of the mold, a groove which receives the bent center of the filament. The ends of the filament are held by movable blocks resting on the bottom of the mold, which movable blocks are held apart against the sides of the mold by the weight of an intermediate block or plug. These movable blocks will be drawn along in the mold by the contraction of the filament in being carbonized, and their friction on the mold caused by their weight will be sufficient to keep the filament under proper strain.

Instead of holding the loop at the center and allowing its ends to draw up, both the center and ends may be held by movable blocks and move toward each other when the filament contracts under carbonization.

The flask is made in two parts—a flat base, upon which the molds are placed in tiers, having lugs or feet on its bottom to allow the circulation of heat beneath the flask, and a cover, which is also the body of the flask, and which is placed over the molds and rests upon the base. The base of the flask may be made of nickel; and with a base of crucible mixture or nickel, the flask may be provided with a double cover—an interior one of nickel and an outer one of crucible mixture.

The foregoing will be better understood by reference to the drawings, in which Figure 1 is a perspective view of the mold with the filament placed therein preparatory to carbonizing; Fig. 2, a top view of one end of the mold and the blocks for holding the ends of the filaments; and Fig. 3, a side elevation of the flask, partly broken away to show the molds therein.

Like letters denote corresponding parts in all the figures.

A is the carbonizing-mold, of plumbago, and a is the fixed block for holding the center of the filament B to be carbonized. This block a may be of plumbago pressed integral with the mold, or of nickel secured in position. The movable blocks are shown at b c, and the separating plug or block at d. The filament

is secured to the blocks b c by pins e f, behind which the enlarged ends of the filament catch, such ends resting in slots in the blocks. The movable blocks b c are made of nickel.

C is the base of the flask, provided with feet g; and D, the cover, forming a chamber for inclosing the molds and contents, both made of suitable refractory material.

What I claim is—

1. A mold for carbonizing slips or filaments formed of plumbago, and constructed, as described, to receive and retain the slips or filaments under strain, while allowing movement for contraction, substantially as set forth.

2. The method of manufacturing carbon loops for incandescing electric lamps, consisting in carbonizing filaments under strain and allowing their limbs alone or their limbs and center to contract together, substantially as set forth.

3. A mold for carbonizing loops for incandescing electric lamps, provided with a fixed or movable block for the center of the loop, and movable blocks attached to the ends of such loop, substantially as set forth.

4. In a mold for carbonizing loops for incandescing lamps, the combination, with the block for the center of the loop, of the movable blocks to which the ends of the loop are attached, and the intermediate separating-plug or equivalent, substantially as set forth.

This specification signed and witnessed this 19th day of September, 1881.

THOS. A. EDISON.

Witnesses:
RICHD. N. DYER,
H. W. SEELY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

PROCESS OF MAKING INCANDESCENTS.

SPECIFICATION forming part of Letters Patent No. 263,145, dated August 22, 1882.

Application filed April 26, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Method of Manufacturing Articles of Carbon, (Case No. 303;) and I do hereby declare that the following is a full and exact description of the same.

In several prior applications for patents by me made are described various methods of manufacturing from various materials the incandescing carbon conductors for the electric lamps used in my system. Such carbons, though differing in materials and methods of manufacture, possessed certain essential unitary or common properties—viz., flexibility and high resistance. Plumbago is, under some circumstances, an excellent and desirable material to use for such purpose, and in an application numbered 27,191 I have described a method of utilizing it for the incandescing conductors of electric lamps.

The object of this invention is to furnish another method for treating carbon, plumbago, and allied substances so that a very flexible, durable, and effective incandescing conductor of any desired resistance may be readily and economically made from such materials. Where for this purpose plumbago or graphitoidal silicon, boron, or zirconium are used the treatment is as follows: The material used is reduced to an impalpable powder, and a quantity thereof is placed in a metal box sufficiently strong to withstand a high pressure. The box should have a perfectly smooth polished bottom, and edges or sides extending upwardly so as to form a chamber about one-sixteenth of an inch deep, or even more, if relatively quite thick sheets are desired. A die with smooth polished face is used, fitting into this box, which is substantially a mold, and may be so designated. The mold is filled with the pulverized material, the top thereof evened off, and the die brought down thereon with great pressure, for which purpose it is preferable to use a hydraulic press. The result is a sheet of homogeneous material whose density depends upon the pressure used, which may be varied to suit the requirements of special purposes.

If it is desired to increase the resistance of the resultant material, the preferable way is to incorporate with the material noted, before pressure into sheets, a proportion of powdered carbon or charcoal. The larger the proportion of carbon or charcoal used the greater the resistance of the sheets of any given density.

As the density may be varied by varying the pressure used, and the resistance regulated by proportioning the amounts of pulverized carbon or charcoal mingled with the basic material, it follows that both density and resistance may be regulated to suit the varying requirements of different systems of lamps.

While all kinds of carbon may be used, as a rule, the substances first mentioned are the easiest of manipulation. If, however, it be desired to use carbons having little or no cohesion—such as charcoal—it may be done by mixing therewith a fluid having in solution a hydrocarbon, the menstruum being one that is readily evaporable, the resultant paste being dried, powdered, pressed, and treated with hydrocarbon vapor, as hereinafter noted.

From the sheets before noted the conductors or "horseshoes" are to be stamped or cut, and so that the enlarged ends for clamping are made homogeneous with the body of the conductor. In such operation there is a certain percentage of loss or breakage. This percentage is materially reduced by treating the sheets with hydrocarbon while heated to incandescence, or at least to a very high heat. To this end the sheets may be placed in a closed flask or retort provided with means whereby hydrocarbon vapor may be passed therethrough over and around the sheets, the flask or retort placed in a furnace, and the sheets brought up to a very high heat; or the material may be heated by electrical incandescence while in a hydrocarbon vapor, the result being that the material becomes tough and flexible.

Instead of the dry powdered material being placed in the mold, it may be made into a paste or dough with any readily-evaporable agent, and the mold filled with the paste or dough and allowed to dry.

The mold may be of any desired size, and it may be of the configuration desired for the loop or horseshoe, so as to form the same di-

rectly, or after the sheets are formed the loops or horseshoes, or any desired shape, may be cut or stamped out, and then treated with the hydrocarbon, as described, instead of the sheets being so treated before cutting or stamping; but the latter is preferable.

What I claim is—

The method of manufacturing incandescing conductors, consisting in pressing the powdered graphite or other material into sheets, then heating the sheets in the presence of a hydrocarbon vapor, as described, and then cutting or stamping the conductors therefrom, substantially as set forth.

This specification signed and witnessed this 19th day of April, 1881.

THOMAS A. EDISON.

Witnesses:

BERNARD J. KELLY,
SAMUEL INSULL.

(No Model.)

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 263,146. Patented Aug. 22, 1882.

Fig. 3.

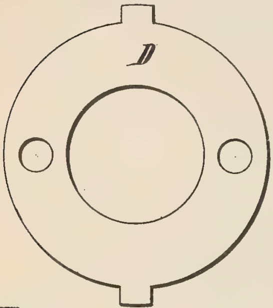


Fig 2.

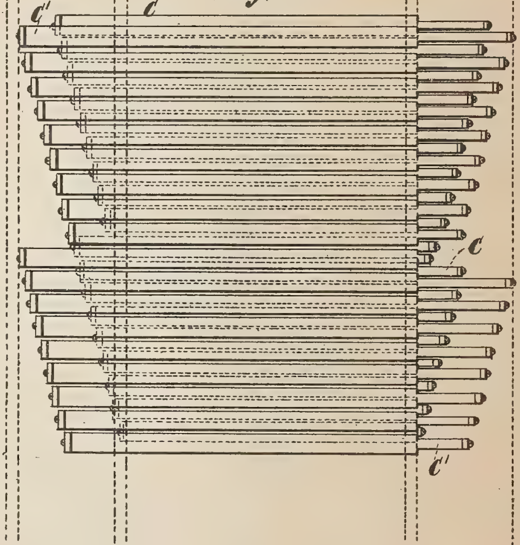


Fig. 4.

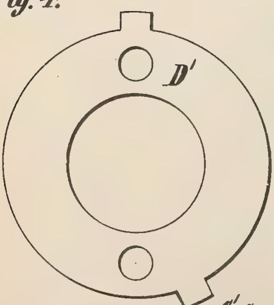


Fig. 1.

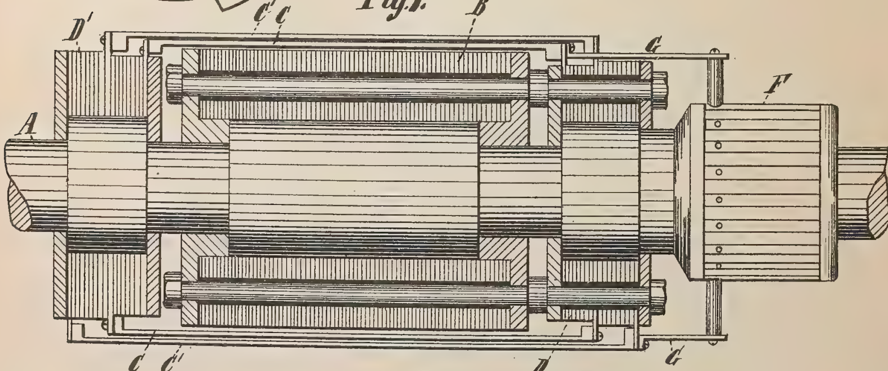
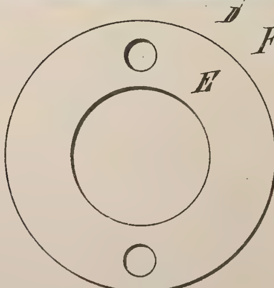


Fig 5



WITNESSES:

O. D. Mott

Thomas E. Birch.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 263,146, dated August 22, 1882.

Application filed November 29, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 372;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to dynamo or magneto electric machines or electric engines of that class wherein the inductive or conducting portion of the armature is composed of longitudinal bars or strips of copper connected at the ends of the armature by copper disks or rings; and my object is to construct and arrange the inductive or conducting bars of such a machine so that the machine will be more economical in construction and the bars can be more conveniently and economically insulated from each other.

In carrying out my invention the alternate bars, instead of being bent over the end connections of the two adjoining bars, as shown and described in my application No. 43,165, filed October 4, 1881, are made straight and are laid upon and wholly outside of the adjoining bars. This enables the bars to be widened, so that those of each layer approach close to one another, two layers of longitudinal bars or strips being thus formed, each of which covers substantially the whole of the armature. These longitudinal bars or strips are connected at their ends by copper disks or rings insulated from each other, the same as if such bars were arranged in one layer. The double winding is in effect a single winding with the alternate bars located in an outer layer. All the inductive bars are separately wrapped with a suitable insulating covering, and in addition the inner layer of bars or plates is separated from the outer layer by additional insulation. At one end of the armature the connections of the alternate bars with the disks are connected with the bars of the commutator-cylinder.

The foregoing will be better understood from the drawings, in which Figure 1 is a section through an armature of a dynamo or magneto electric machine embodying my invention; Fig. 2, a view of the bars or strips laid out, the vertical dotted lines representing the plates between which the cross connecting disks or rings are clamped. Figs. 3 and 4 are views of the copper disks or rings, and Fig. 5 the insulating disk or ring.

A is the armature-shaft, upon which is secured the core B of the armature.

C C′ are the longitudinal bars or strips of copper, and D D′ the cross connecting rings or disks of copper, those of each set being separated by disks or rings of insulating material E.

F is the commutator-cylinder, and G the rods extending from the junctures of alternate bars with the lugs on the disks, to the bars of such commutator-cylinder. These outside commutator-connections may have the full conducting-power of the inductive bars themselves. The bars of each layer are arranged opposite the spaces between the bars of the other layers, or so that the bars of the two layers will break joints. This permits the use of the outside commutator-connections, which, for bars of the inner layer, pass between the lugs on the bars of the outer layer, such lugs being narrowed for that purpose at that end of the machine, as shown in Fig. 2.

It is evident that three or more layers of copper bars or strips with cross connecting disks or rings and outside commutator-connections might be arranged in this way without departing from the spirit of my invention.

What I claim is—

1. In armatures for dynamo or magneto electric machines or electric engines, the two layers of copper bars or strips, in combination with cross connecting disks or rings, substantially as set forth.

2. The combination, with the two layers of copper bars or strips and the cross connecting disks or rings, of the outside commutator-connections, substantially as set forth.

3. In armatures for dynamo or magneto electric machines or electric engines, the com-

bination of the two layers of copper bars or strips breaking joints, substantially as set forth.

4. The combination of the two layers of copper bars or strips, arranged to break joints, the cross connecting disks or rings, and the outside commutator-connections, substantially as set forth.

This specification signed and witnessed this 22d day of November, 1881.

THOS. A. EDISON.

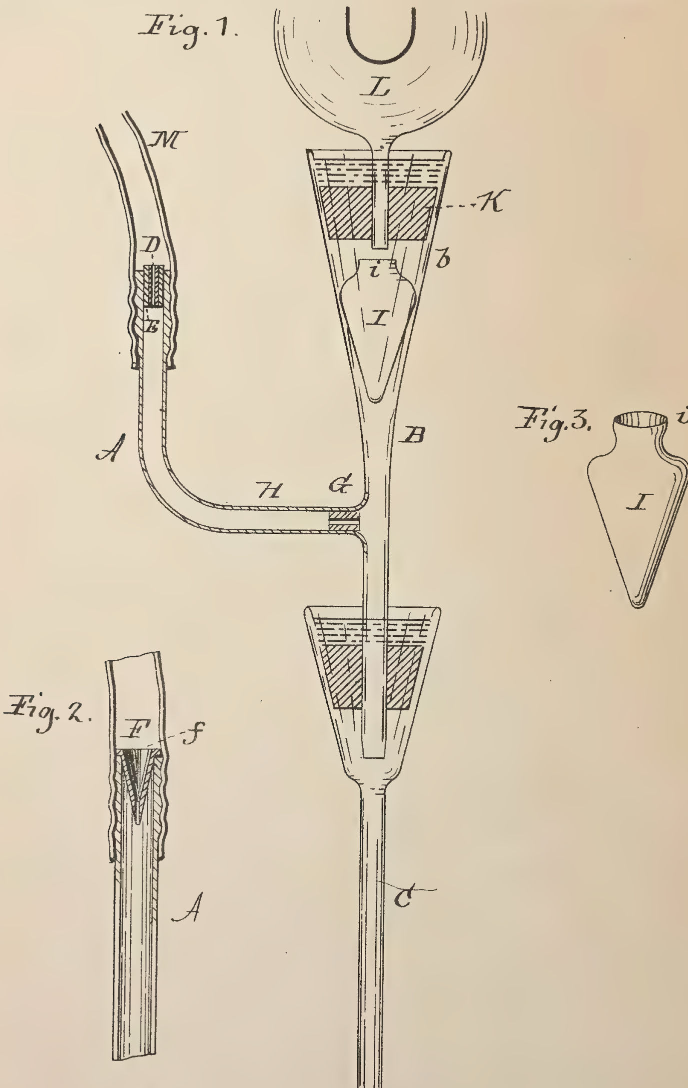
Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

VACUUM APPARATUS.

No. 263,147. Patented Aug. 22, 1882.



WITNESSES:

O. D. Mott

M. J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

VACUUM APPARATUS.

SPECIFICATION forming part of Letters Patent No. 263,147, dated August 22, 1882.

Application filed August 30, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Vacuum Apparatus, (Case No. 336;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce a simpler, cheaper, and more efficient construction of the Sprengel drop-pump for producing high vacuo.

In carrying out my invention I provide the pump with the following novel features:

First. Instead of using the contraction made directly in the glass for regulating the flow of mercury, as has been practiced by me generally heretofore, I provide the first drop-tube with an inner tube having a fine bore of definite size held removably in the glass drop-tube. This inner regulating-tube is made of metal, glass, or other hard material, and is held preferably by a rubber stopple which surrounds it and is forced into the end of the drop-tube; or, the inner tube may be formed in the apex of a small funnel of proper material, having a flange resting upon the end of the glass drop-tube. Several advantages are secured by the use of this inner removable tube over the contraction made directly in the glass. The drop-tube will not be broken by the jumping up of the mercury, which in case of the glass contraction strikes the same and shatters the tube at that point. The size of the inner tube can also be changed without difficulty if it is desired to vary the flow of the mercury. The inner tube can be readily removed for cleaning it and for cleaning the drop-tube.

Second. In that form of Sprengel drop-pump where two drop-tubes are used connected by a cross-tube, forming what may be called the "trap-tube," and the trap-tube is secured to the second drop-tube by fusion of the glass at the junction, it is exceedingly difficult, if not impossible, to make the opening at the juncture of a definite predetermined size. I accomplish this by sealing within the glass at said juncture a short tube of platinum or an extra glass tube having a bore of the size it is desired to give the opening. The coefficient of expansion of platinum being practically the same as that of glass, the glass will not be broken, nor will the joint between the glass and platinum be injured by the expansion and contraction of the parts when a platinum tube is used. By using the platinum or extra glass tube at this juncture the pumps can be made mechanically alike.

Third. Instead of using a separate bulb connected with the second drop-tube for containing the phosphoric anhydride or other drying agent, I place such drying agent directly in the enlarged upper end of this drop-tube, beneath the mercury-sealed stopple supporting the lamp or other chamber to be exhausted. A vessel constructed of proper material is used to hold the drying agent, around the sides of which vessel the air is drawn downwardly. The vessel has a contracted mouth, so that any mercury which may run into the top of the tube will not enter the vessel.

In the drawings, Figure 1 is an elevation and partial section of the principal parts of a Sprengel drop embodying my improvements; Fig. 2, a view of a modified form of the inner or regulating tube; Fig. 3, a separate view of the vessel for containing the drying agent.

A is the first drop-tube, B the second drop-tube, and C the fall-tube, all of glass. The first drop-tube, A, is preferably bent at or near a right angle, entering the second drop-tube, B, nearly or quite horizontally. If thus bent, the horizontal or nearly horizontal portion forms what may be called the "trap" H, but which is an integral portion of the first drop-tube.

D is a tube, of iron, glass, or other hard material, having a fine bore of definite size and held by rubber stopple E in the upper end of the glass drop-tube A. In Fig. 2 the tube is shown as formed at the apex of a funnel, F, having a shoulder or flange, *f*, resting on the upper end of tube A, a suitable washer being provided, if necessary, to make a tight joint.

G is the tube, of platinum or glass, sealed into the glass at the junction of the first drop-tube, A, with second drop-tube, B, and in the portion of the drop-tube A hitherto designated as the "trap H." It is evident that this means of join-

ing any two tubes in the pump where a definite-sized orifice is desired at the junction may be advantageously used.

I is the vessel for containing the phosphoric anhydride, having contracted mouth *i*, and it is set into the enlarged upper end, *b*, of B below the mercury-sealed stopple K, supporting lamp L or other vessel to be exhausted.

M is a pipe leading to the mercury-reservoir, while the fall-tube C leads to a receptacle from which the mercury is raised to the reservoir by suitable means and used over again.

What I claim is—

1. In a Sprengel drop-pump, a drop-tube having an inner tube forming the strangulation or contraction for the mercury and removably secured within it, substantially as set forth.

2. In a Sprengel drop-pump, the removable inner tube, for the purpose set forth, held by a stopple or surrounding packing, substantially as set forth.

3. In a Sprengel drop-pump, the combination, with the two drop-tubes, of a section of tube sealed within one of the drop-tubes at the junction of the two drop-tubes and forming a contraction thereat, substantially as set forth.

4. The combination, with the exhaust-tube of a Sprengel air-pump, of a separate vessel placed in said exhaust-tube between the inlets of the vessel to be exhausted and the mercury for effecting the exhaustion, and adapted to contain a drying agent, substantially as set forth.

This specification signed and witnessed this 1st day of July, 1881.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,

H. W. SEELY.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 263,148. Patented Aug. 22, 1882.

Fig. 1.

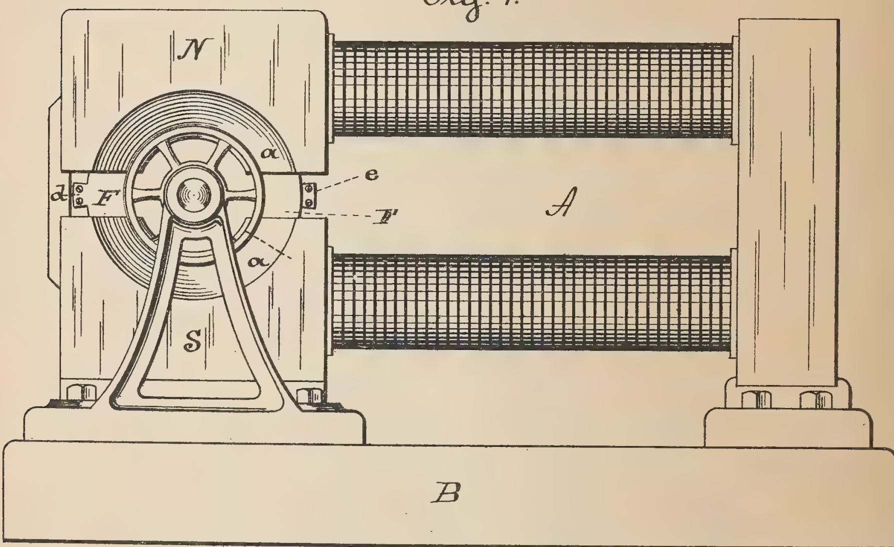


Fig. 4.

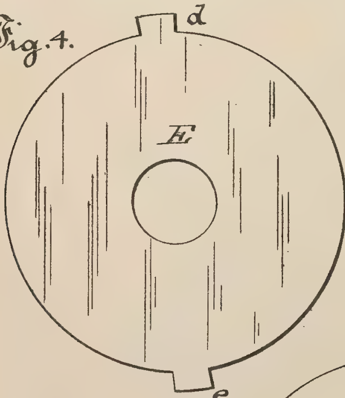


Fig. 5.

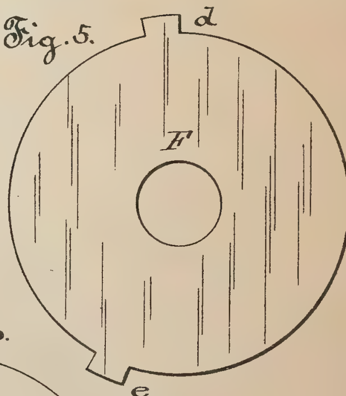
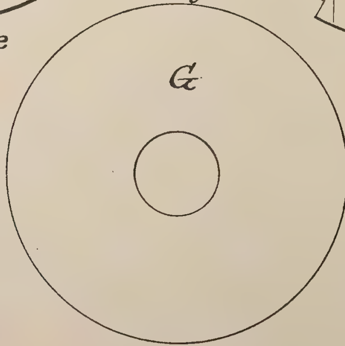


Fig. 6.



WITNESSES:

O. D. Mott.
J. Ellis Clark.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS. Photo-Lithographer. Washington. D. C.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 263,148. Patented Aug. 22, 1882.

Fig. 2

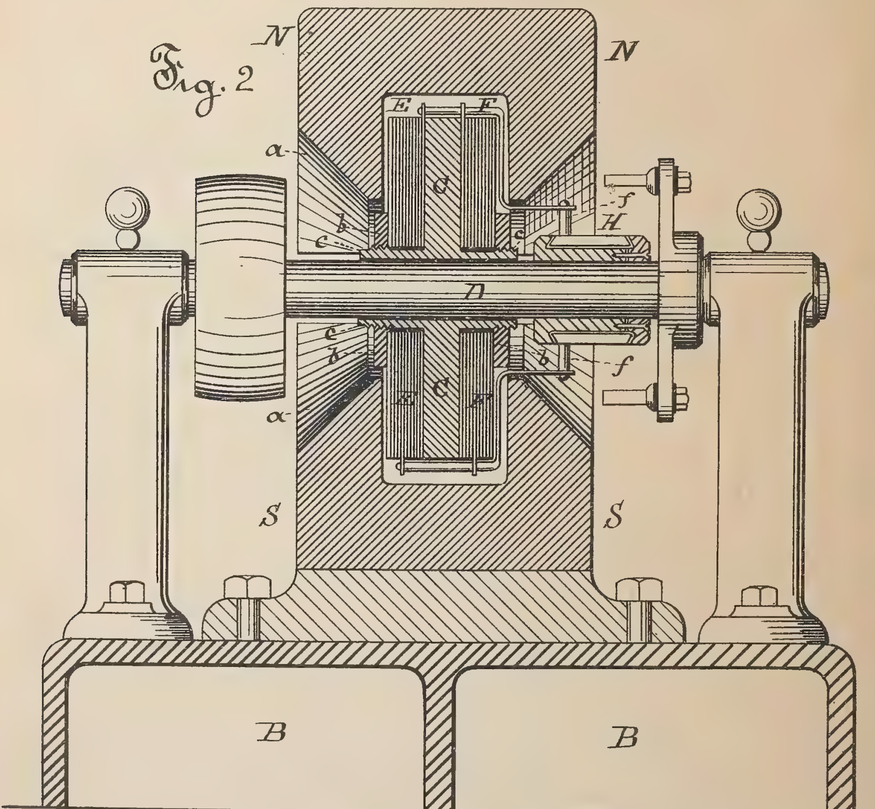
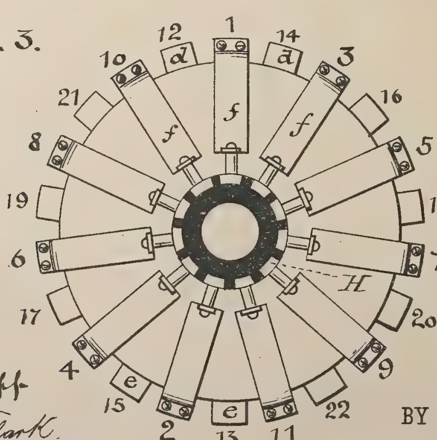


Fig. 3.



WITNESSES:

S. D. Mott
J. Ella Clark.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 263,148, dated August 22, 1882.

Application filed November 28, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 360;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to produce an improved form of dynamo or magneto electric machine, or electric engine which shall possess the features of exceedingly low resistance and great strength, compactness, and economy. This I accomplish by the use of copper disks, which form the inductive portion of the revolving armature and from which a continuous current of electricity is taken. These copper disks are arranged in two sets placed on opposite sides of an iron plate, which is of circular shape and forms the core of the armature. The disks are securely clamped together and to this central plate or core, properly-insulating disks being placed between the separate disks and also next to the core. The exciting-magnet has its polar extensions placed on opposite sides of the peculiar armature, and these are extended on the sides of the armature toward the shaft of the same, the extended sides being beveled, so that the direct attractive force between such polar extensions will be small compared with that between the polar extensions and the core of the armature. The copper disks on one side of the central plate or core all have currents set up in the same direction, but in the opposite direction to those on the other side. Cross-connections are provided at the periphery of the disks, which connect the disks in series, so that an electro-motive force is generated, due to all the disks, and connections are made with the commutator-cylinder upon which bear the commutator-brushes.

The foregoing will be better understood from the drawings, in which Figure 1 is a side elevation of the machine; Fig. 2, a vertical cross-section of the same on the line of the armature-shaft; Fig. 3, an elevation of the commutator end, the commutator-cylinder being in section; Figs. 4 and 5, elevations of copper inductive disks, and Fig. 6 an elevation of an insulating-disk.

Similar letters denote corresponding parts in all six figures.

N S are the polar extensions of the field-magnet A, which is mounted upon a suitable base, B. These polar extensions are hollowed out on their inner faces, forming chambers which inclose opposite portions of the armature and through which said armature revolves. The sides of the polar extensions N S are beveled, as shown at *a*, so as to reduce the attractive force acting directly across between the polar extensions. The armature is composed of an iron core, C, which is a circular plate keyed to the shaft D, and two sets, E F, of copper disks. These disks are placed on opposite sides of the central plate or core, C, and are insulated from each other and from the core by disks G of insulating material, preferably of paper. The disks are clamped together and to the core by brass screw-rings *b*, turning on the ends of the extended hub *c* of the core; but the disks may be secured in addition by bolts passing directly through them. The disks have projections *d e* on their periphery. The projections of the two sets of disks are joined by cross-connections, so that the disks will be connected in a continuous and symmetrical series. H is the commutator-cylinder, to which the disks are connected by rods or plates *f*, the alternate connections of the disks with each other being shown as thus connected with the bars of the commutator-cylinder. The lines of force at each pole of the exciting-magnet move between the pole and the core of the armature on each side of said core. The disks of each set cut in opposite direction on their opposite portions the lines of force from the opposite poles of the magnet. Hence the currents generated in the disks of each set flow all in the same direction. The disks of one set cut in each field lines of force moving in the opposite direction from those cut by disks of the other set in the same field. Hence the currents generated in one set of disks flow in the opposite direction to

those generated in the other set. This armature, it will be seen, will have an exceedingly low resistance, and will be compact and strong.

What I claim is—

1. The combination, with the field magnet or magnets of a dynamo or magneto electric machine, of a number of inductive disks connected so as to generate a continuous current, substantially as set forth.

2. The inductive disks revolving in two opposite fields of force and connected so as to generate a continuous current, substantially as set forth.

3. The combination, with the exciting magnet or magnets, of the revolving armature having a magnetic plate or disks and copper inductive disks, substantially as set forth.

4. The combination, with the exciting-magnet, of the armature having a central plate or disk of magnetic metal forming the core of the armature, and inductive disks arranged on opposite sides of such core and connected so that such disks shall generate a continuous current, substantially as set forth.

5. The combination, with the exciting-magnet, of the armature having central core and copper inductive disks on each side of the core, the cross-connections of such disks at their periphery, and the exterior commutator-connections, substantially as set forth.

6. The combination, with the revolving armature provided with a core of magnetic metal and inductive portions, of an exciting-magnet having polar extensions chambered to receive opposite portions of the armature, and reduced in width on their approaching faces, substantially as set forth.

This specification signed and witnessed this 25th day of October, 1881.

THOS. A. EDISON.

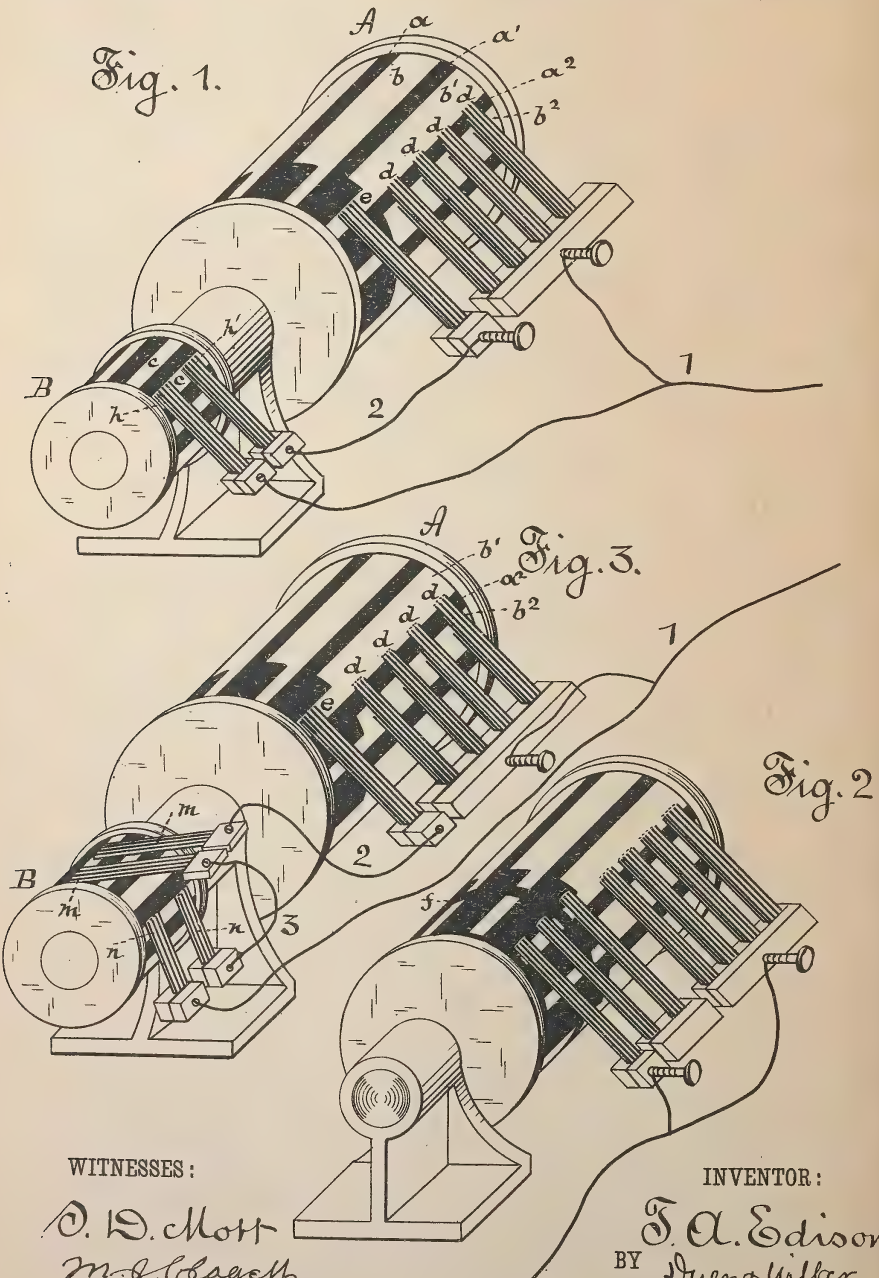
Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

COMMUTATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

No. 263,149. Patented Aug. 22, 1882.



WITNESSES:

O. D. Mott
M. J. Clagett

INVENTOR:

T. A. Edison
BY Dyer & Wilber
ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

COMMUTATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 263,149, dated August 22, 1882.

Application filed October 4, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Commutators, (Case No. 338;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In the operation of magneto or dynamo electric machines a spark is produced at each set of commutator-brushes as they pass from one bar of the commutator-cylinder to another. This spark is caused, first, by the breaking of a strong local current produced by the brushes bridging the insulation between two bars; and, second, by breaking a portion of the main current at the same time. Since it is extremely difficult, if not impossible, to adjust the brushes so that they will leave a commutator-bar exactly together, this spark at each set of brushes is usually taken principally by one brush until that is reduced in length by the heat of the spark, when it is taken by another brush. In large and powerful dynamo or magneto electric machines the sparks produced in this manner are exceedingly large, the result being a considerable waste of energy, which is converted into heat and injures the face of the commutator and the brushes that bear thereon.

The object, therefore, of my invention is to produce means for reducing the sparks at the commutators of these machines to the minimum.

In carrying out my invention I widen the insulation and narrow the conducting-bars at one end of the commutator-cylinder, and I arrange to bear upon this portion of said cylinder, on each side thereof, a single commutator-brush whose bearing end is noticeably behind the ends of the main brushes beside which it is placed—that is to say, the end of this brush bears upon the commutator-cylinder at a point which has already passed the main brushes. This brush, which I term for purpose of distinction the "isolated" brush, is not connected with the main brushes directly, but is connected with a series of breaking-points resting on a "breaking-cylinder," which breaking-cylinder has conducting-bars and insulating-spaces corresponding with those upon which the isolated brush bears. This cylinder may be a separate cylinder mounted on the end of the shaft of the machine, or it can be a continuation of the commutator-cylinder, its conducting-bars being insulated from those of the commutator-cylinder. There may be two or four, or any other desired number of these breaking-points connected with the isolated brush on each side of the machine, the first point of each series being connected with the isolated brush and the last point with the main wire.

In the working of the machine the local circuit and a portion of the main circuit are continued through each isolated brush after the main brushes have left each commutator-bar, so that no spark is produced at the points of the main brushes. When each isolated brush leaves a commutator-bar the current passing through it is also broken at a number of points on the breaking-cylinder simultaneously with the breaking of the current on the commutator-cylinder by the isolated brush. In this manner the spark is divided up and the total spark greatly reduced, it being a discovery of mine that the spark at each point is reduced about as the square of the number of points at which the circuit is broken. Hence if two breaking-points are connected with each isolated brush, the spark at each point will be about one-ninth of what the entire spark would ordinarily be. It is evident that this same arrangement could be used for the commutators of electro-motors, and for other machines where the bad effect of a large spark is to be obviated.

In the annexed drawings, Figure 1 represents a commutator in which a separate breaking-cylinder is used; Fig. 2, one in which only one cylinder is used; and Fig. 3 shows the manner of connecting a large number of breaking-points.

In Figs. 1 and 3, A is the commutator-cylinder, $a\ a'\ a^2$ being insulating-spaces, and $b\ b'\ b^2$ conducting-bars of its surface. The conducting-bars are narrowed and the insulating-spaces widened at the outer end of the cylinder.

B is the breaking-cylinder, whose conducting-bars $c\ c'$ correspond to those at the outer end of the commutator-cylinder.

d d are the main commutator-brushes, which take off the current and convey it to the wire 1. *e* is the isolated brush, connected by the wire 2 to the brushes *h h'*, Fig. 1, on the breaking cylinder. The conducting-bars of the breaking-cylinder, are of such width that the brushes *h h'* break circuit simultaneously with the brush *e*.

In Fig. 3 four brushes, *m m n n*, are used, all making and breaking circuit simultaneously with *e*, the last brush *m* being connected by wire 3 to the first brush *n* and the last brush *n* to the main wire 1.

In Fig. 2 only one cylinder, C, is used, divided by an insulating-section, *f*, into two parts, one part forming the commutator-cylinder and the other the breaking-cylinder. The arrangement and connection of the brushes are similar to the construction shown in Fig. 1. In all these cases similar brushes or sets of brushes are of course placed at the opposite side of the commutator to correspond with the other pole of the machine.

What I claim is—

1. A series of commutator-brushes, one of which is set noticeably behind and is connected with the main conductor, independent of the other brushes, through breaking points, substantially as and for the purpose described.

2. The combination, with the commutator brush or brushes of a dynamo or magneto electric machine, of two or more circuit-breaking points arranged in series and breaking circuit simultaneously with the breaking of the circuit at the commutator, substantially as set forth.

3. A commutator-cylinder having parallel conducting-spaces which are narrower at one end, the insulating-spaces being then proportionately wider, in combination with positive and negative brushes bearing on both the narrower and wider portions of said spaces, substantially as set forth.

4. The combination, with the commutator-cylinder and its brushes, of a breaking-cylinder mounted on the same shaft and provided with means for breaking the circuit at several points simultaneously with the breaking of the circuit at the commutator, substantially as set forth.

5. The combination, with the isolated brush of the commutator, of two or more brushes on the breaking-cylinder, which break circuit simultaneously with the isolated brush, substantially as set forth.

This specification signed and witnessed this 22d day of July, 1881.

THOMAS A. EDISON.

Witnesses:

RICHD. N. DYER,

H. W. SEELY.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

MAGNETO OR DYNAMO ELECTRIC MACHINE.

No. 263,150. Patented Aug. 22, 1882.

Fig. 1.

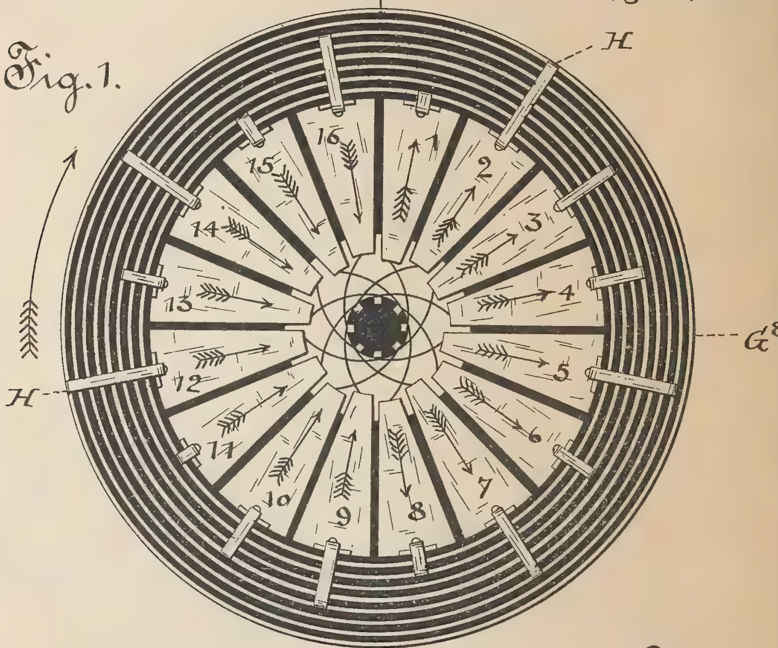
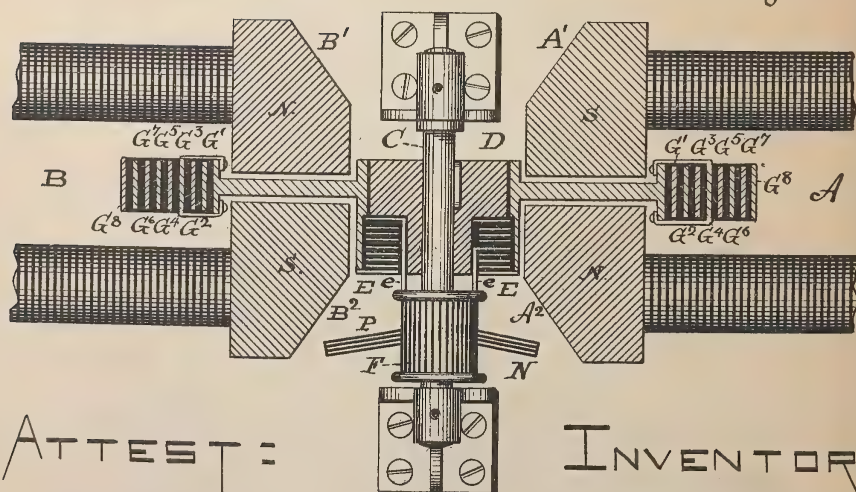


Fig. 2.



ATTEST:

O. D. Mott

M. J. Clagett.

INVENTOR:

T. A. Edison

per. Dyer & Wilber Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

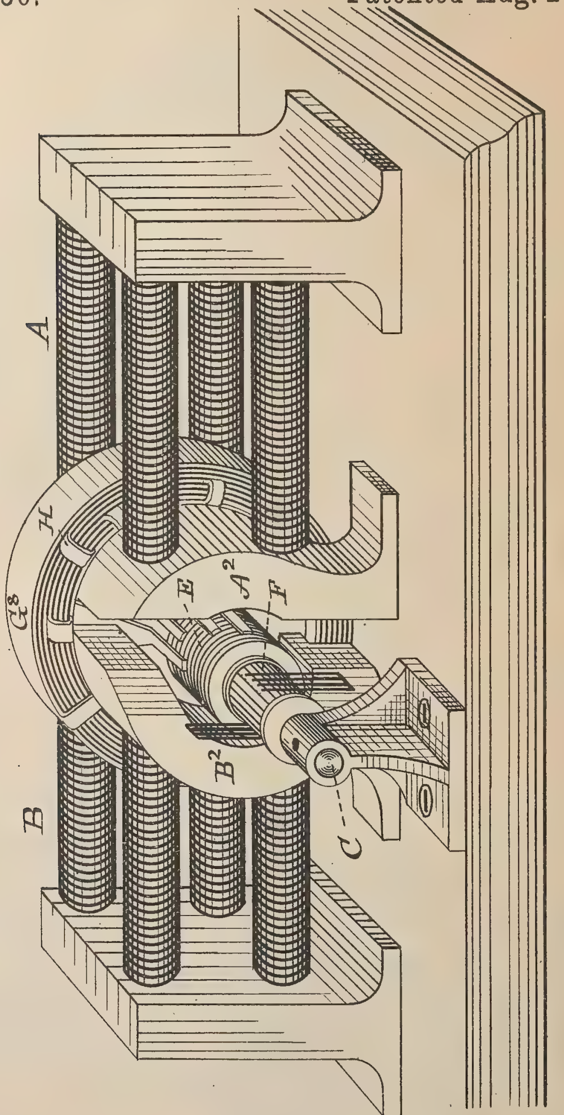
(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

MAGNETO OR DYNAMO ELECTRIC MACHINE.

No. 263,150. Patented Aug. 22, 1882.

Fig. 3.



ATTEST

O. D. Mott

M. J. Clagett

per.

INVENTOR:

T. A. Edison

Dyer & Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MAGNETO OR DYNAMO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 263,150, dated August 22, 1882.

Application filed June 22, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Magneto or Dynamo Electric Machines or Electric Engines, (Case No. 331;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce a dynamo or magneto electric machine in which the iron core of the armature will not be necessary and the loss of power caused by the heating of the same will be avoided, only the inductive portion of the armature being passed between the poles of the exciting magnet or magnets, which poles can consequently be brought close together, so as to produce an intense magnetic field; and my object is, further, to construct a machine of this character so that it will generate a continuous current of high electro-motive force in the same direction without the use of pole-changers. All the inductive portions of the armature will be constantly in circuit, and the internal resistance of the machine will be exceedingly small.

I accomplish this object by constructing the armature in the shape of a disk or plate like that used by Arago in his experiments, but divided into radial sections. These radial sections, which form the inductive portion of the armature, are preferably naked copper bars connected together by insulating material and attached rigidly to the driving-shaft by an insulating-hub. At their inner ends these bars are connected in pairs, preferably by means of metal plates insulated from each other, which plates have tongues secured in the grooves of an insulating commutator-cylinder. The radial bars revolve between the polar extensions of a magnet or magnets, (two magnets being preferred for this purpose,) and outside of such polar extensions the disk formed of radial bars and insulating material is surrounded by concentric metal rings, which are insulated from each other and the radial bars, except as hereinafter explained. The number of the rings is one-half that of the radial bars. The pairs of bars are connected in multiple arc at their outer ends by these concentric rings, straps, bands, or rods being used for this purpose, said straps, bands, or rods extending from the bars to the rings, and being insulated from all the rings except the ones they are intended to connect with the bars. Instead of using separate bands, straps, or rods to connect the bars with the rings, such bars can be forked and extend up on each side of the rings, the proper rings being extended to make connection with the bars. This construction is stronger than that before described, and offers less resistance to the passage of the current. The rings connect the bars in such manner that the connections are symmetrical at every position of the machine. The rings are complete, and extend in both directions from and to the connecting bands, straps, or rods, so that the plates are connected in multiple arc, half the current passing in each direction. This makes a more symmetrical and stronger construction than if partial rings were used, and the resistance is less. The current, commencing at the negative commutator brush or spring, is divided into two parts, each of which parts passes through one-half of the radial bars and combines with the other part at the positive commutator brush or spring. In this manner all the bars are continually kept in circuit and a current is generated having an electro-motive force due to one-half the length of all the plates. The concentric rings are arranged outside of the polar extensions so that such extensions can be brought close up to the inductive bars, while the rings are nearly outside of the magnetic field, and do not cut the lines of force at right angles, and consequently have no counter effect upon the electro-motive force of the current. The plates connecting the radial bars with the commutator, the concentric rings, the connecting bands, straps, or rods, and the radial bars themselves, all having large conducting area, the internal resistance of the machine will be exceedingly small. The radial bars could be cut away at three or more points to make room for metallic arms, in order to strengthen the armature, without seriously detracting from the efficiency of the machine.

The novel features of this machine are equally well applicable to electric engines and mo-

tors, and this description is intended by me to be understood as covering the same. As an engine or motor the construction would have the advantage of great lateral compactness, enabling me to use the engine on a narrow railway-car without projecting over the sides of the same, or in other locations where space is limited.

In the drawings, Figure 1 is an elevation of the revolving armature with the commutator in section, the connections of the radial bars with the commutator being shown diagrammatically; Fig. 2, a central horizontal section of the machine, and Fig. 3 a perspective view of the machine.

Like letters denote corresponding in all three figures.

A' A^2 and B' B^2 are the polar extensions of the electro-magnets A B, which are preferably arranged, as shown, on opposite sides of the driving-shaft C.

The radial naked copper bars, which are numbered 1 to 16, inclusive, are mounted upon a hub, D, secured to the shaft and properly insulated from such shaft. Sixteen radial bars are shown for purposes of illustration; but the number might be more or less, according to the size of the machine. These bars are joined edgewise by a non-conducting material, so that they form a rigid disk or plate. The radial bars are turned outwardly at their lower ends and connected thereby, or by rods, with plates E, which are insulated from each other and have tongues *e*, two of which are shown in Fig. 2, extending outwardly and forming the conducting portions of the commutator-cylinder F.

Two radial bars are connected with each plate E, and by it connected with the nearest central commutator-bar. In the arrangement shown the pairs 1 and 8, 2 and 11, 3 and 10, 4 and 13, 5 and 12, 6 and 15, 7 and 14, 9 and 16 are connected together and to central commutator-bars. The concentric rings G' to G^8, inclusive, surround the disk formed by the radial bars, outside of the polar extensions A' A^2 B' B^2, and are separated from such disks and one another by a suitable insulating material. The radial bars are connected in couples by these rings, bands, straps, or rods H being used for that purpose. As shown, bars 1 and 11 are connected by ring G', 8 and 15 by G^2, 6 and 13 by G^3, 4 and 10 by G^4, 3 and 9 by G^5, 7 and 16 by G^6, 5 and 14 by G^7, and 2 and 12 by G^8. The neutral line extends vertically through the center of the armature, while the commutator brushes or springs P N make contact with the sides of the commutator-cylinder at the ends of its horizontal diameter, the bars next to the neutral line being connected with the central side commutator-bars, as shown and previously explained. On the left-hand side of the neutral line the currents in the radial bars, as shown in Fig. 1, all run inwardly, while those on the right-hand side flow outwardly. In the position shown one portion of the current would pass from the negative to the positive commutator-brush, *via* 1, G', 11, 2, G^8, 12, 5, G^7, 14, 7, G^6, and 16 and the other portion *via* 8, G^2, 15, 6, G^3, 13, 4, G^4, 10, 3, G^5, and 9, the proper plates E and straps H being included in the circuits.

By dividing the disk into radial sections or bars and connecting them, so as to generate a continuous current, a much higher electro-motive force can be obtained than by the use of the simple undivided disk employed by Arago in his experiments.

What I claim is—

1. The armature of a dynamo or magneto electric generator or engine, consisting of a series or number of separate radial disk-sections electrically insulated from each other, but mechanically connected together to form a rigid disk, substantially as set forth.

2. The combination, with an armature of a dynamo or magneto electric generator or engine, formed of a series or number of separate radial disk sections or bars electrically insulated from each other, but mechanically connected to form a rigid disk, of commutator bars and connections, substantially such as described, all the radial disk sections or bars being thereby kept continuously in circuit, substantially as set forth.

3. The combination, in an armature for a dynamo or magneto electric generator or engine, of separate radial disk sections or bars electrically insulated from each other, but mechanically connected together to form a disk, and concentric rings connecting the disk sections or bars in a multiple arc, substantially as set forth.

4. A magneto or dynamo electric machine or electric engine having, in combination, the armature constructed of radial bars connected in pairs at their inner ends with the commutator-bars and suitable connections of different pairs at the outer ends of the radial bars, whereby the radial bars will all be kept continuously in circuit, substantially as set forth.

5. In a dynamo or magneto electric machine or electric engine, the combination, with the armature, of the concentric rings for connecting the armature-bars in multiple arc, revolving outside of the polar extensions of the magnet or magnets, substantially a set forth.

6. In a dynamo or magneto electric machine or electric engine, the combination, with the radial bars, of the concentric rings outside of the radial bars and connections between such bars and rings, substantially as set forth.

This specification signed and witnessed this 3d day of June, 1881.

T. A. EDISON.

Witnesses:

RICHD. N. DYER,

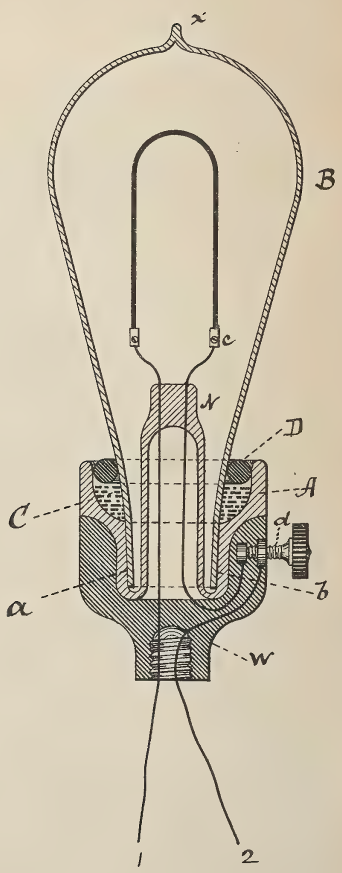
H. W. SEELY.

(No Model.)

T. A. EDISON.

ELECTRIC LAMP.

No. 263,878. Patented Sept. 5, 1882.



Attest:

S D Mott

F. W. Howard

Inventor:

Thos. A. Edison

per Dyer & Wilber

Attys

N PETERS. Photo-Lithographer. Washington. D C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 263,878, dated September 5, 1882.

Application filed December 15, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescent Electric Lamps, (Case 271;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

My invention relates to that class of electric lamps in which the light is caused by the incandescence of a carbon filament, and has for its object the production of an arrangement which will maintain a vacuum in the globe which contains the carbon.

In prior applications and patents I have shown methods of sealing the various parts of the lamp together by a fusion of the glass itself, thereby forming at the joints a vitreous seal of the same character and durability as the body of the lamp itself. Under some circumstances an unfused seal may be sufficient, the parts being put together so that while a joint practically tight for a limited period is secured they may, when desired, be separated. To accomplish this may be stated as the special object of the invention hereinbefore set out in more general terms. My arrangement for this purpose consists in setting the globe in a glass socket, both being ground, so that they will fit tightly together. Afterward, the space left being filled with mercury and a packing of rubber used to close the whole tightly and retain the mercury in the space, the air is exhausted from the globe at its top, which is then sealed, so that a vacuum is maintained.

The accompanying drawing is a sectional view of a lamp constructed according to my invention.

W is an insulating-base, usually of wood. A is the glass socket fitting therein. It is, when seen in section, somewhat of the form of the letter W, the central limb being extended upwardly and forming a support for the wires leading to the clamps, the wires being suitably sealed therein, this central portion extending up within the body of the globe B. The socket A is ground at *a* and the globe B correspondingly ground at *b*, so that they fit tightly together. A space, C, is thus left, which is filled in with mercury, forming a liquid seal. Above the mercury is placed a rubber ring, D, which fits tightly and prevents the mercury from escaping.

1 2 are the wires of the circuit, by which electricity is supplied to the lamp. These wires terminate in the platinum clamps *c*, which hold the carbon. A portion of the circuit is formed by the screw *d*, which may be drawn back to break the circuit and extinguish the lamp, or vice versa.

After the globe B is blown a stem remains at *x*, by means of which the air is exhausted, and the globe is then sealed and the stem broken off, leaving the globe perfectly air-tight and keeping a vacuum in its interior.

What I claim is—

1. The central tube conductor or support for the incandescing conductor, formed with a chamber at its base and fitted to receive tightly therein the neck of the inclosing globe, substantially as set forth.

2. In an incandescing lamp, the combination of the chambered central tube or support and the inclosing globe, ground or adapted to fit tightly, substantially as described.

3. The combination, in an incandescing lamp, of the chambered central tube or support adapted to hold a liquid seal, the inclosing globe having a neck fitted to the chamber, and a packing for securing the liquid seal, substantially as set forth.

This specification signed and witnessed this 3d day of December, 1880.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
WM. CARMAN.

(No Model.)

3 Sheets—Sheet 1.

T. A. EDISON.

ELECTRIC DISTRIBUTION AND TRANSLATION SYSTEM.

No. 264,642. Patented Sept. 19, 1882.

Fig. 1.

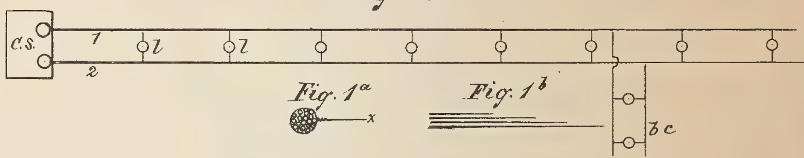


Fig. 2.

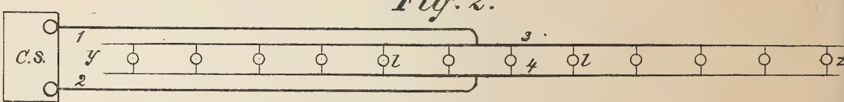


Fig. 3.

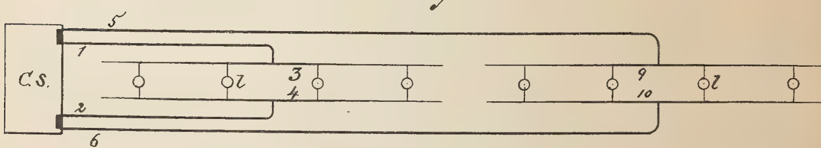


Fig. 4.

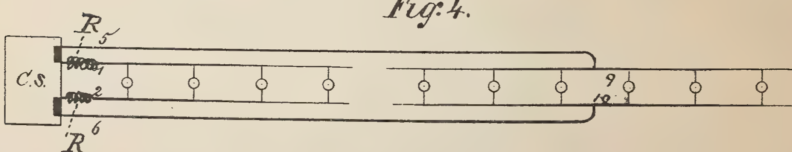
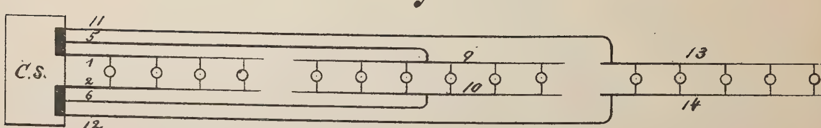


Fig. 5.



Witnesses:

F. W. Howard
James A. Payne

Inventor:

T. A. Edison
per Dyer & Wilber
Attorneys.

(No Model.) 3 Sheets—Sheet 2.

T. A. EDISON.

ELECTRIC DISTRIBUTION AND TRANSLATION SYSTEM.

No. 264,642. Patented Sept. 19, 1882.

Fig. 6.

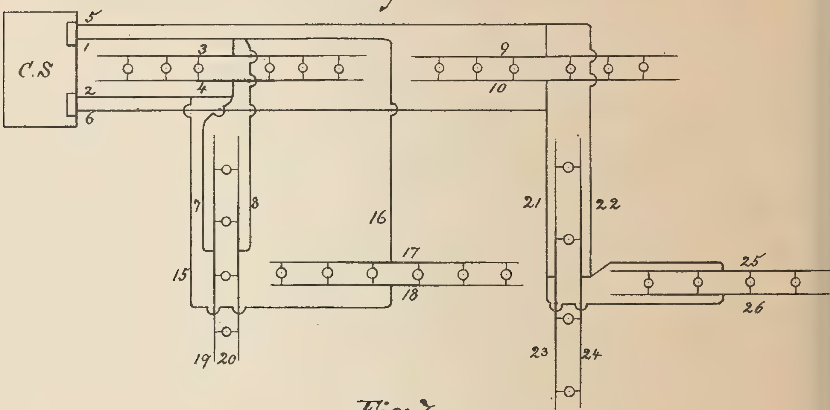


Fig 7.

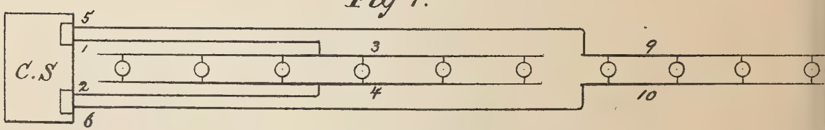


Fig. 8.

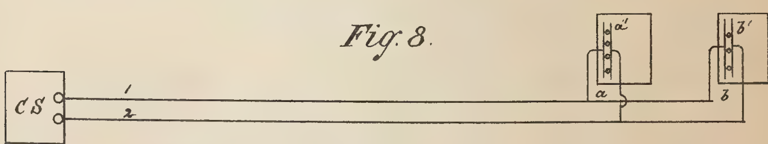


Fig. 9.

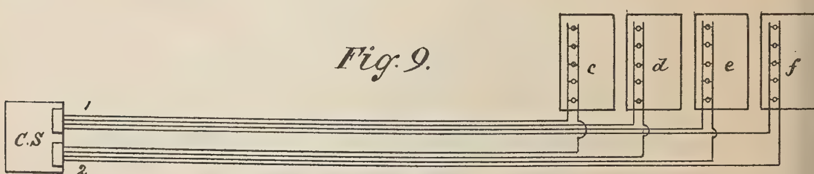
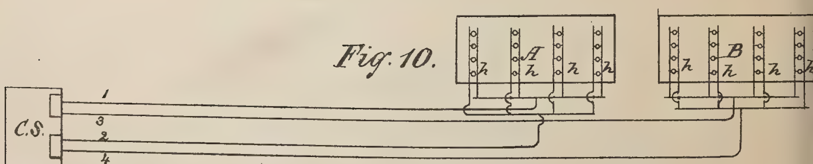


Fig. 10.



Witnesses:

F. W. Howard
James A. Payne.

Inventor:

T. A. Edison
per Dyer & Wilber
Attorneys.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.)

3 Sheets—Sheet 3.

T. A. EDISON.

ELECTRIC DISTRIBUTION AND TRANSLATION SYSTEM.

No. 264,642. Patented Sept. 19, 1882.

Fig. 11.

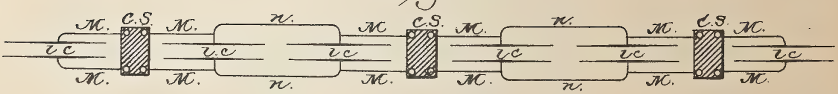
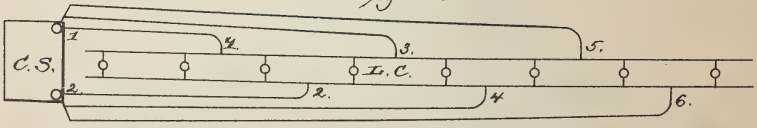


Fig. 12.



Witnesses:
J. C. Clark.
H. A. Clark.

Inventor:
Thomas A. Edison
By Richd. N. Dyer,
Attorney.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC DISTRIBUTION AND TRANSLATION SYSTEM.

SPECIFICATION forming part of Letters Patent No. 264,642, dated September 19, 1882.

Application filed August 9, 1880. (No model.) Patented in England September 24, 1880, No. 3,880; in Canada November 15, 1880, No. 11,997; in Italy November 19, 1880; in Belgium November 30, 1880, No. 53,018; in France January 3, 1881, No. 139,588; in Victoria January 4, 1881, No. 2,944; in Austria February 3, 1881; in New South Wales March 7, 1881; in New Zealand March 7, 1881, No. 512; in Queensland March 9, 1881; in Spain April 2, 1881, and in India July 20, 1881, No. 528.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Electric Distribution and Translation System, (Case No. 236;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This invention relates to a method of equalizing the tension or "pressure" of the current through an entire system of electric-lighting or other translation of electric force, preventing what is ordinarily known as a "drop" in those portions of the system the more remote from the central station, and also to other features in systems for the utilization of electricity, as hereinafter explained.

As is well known from patents already granted me and prior applications pending, I use in my system an electric light formed of a continuous incandescing conductor, large numbers of which are grouped into one system, supplied and regulated from a central station, main conductors leading from and to the central station, each lamp or translating device being in a derived circuit to the main conductors, the entire system being what is known as a "multiple-arc" system. From a central station the main conductors may proceed, and it is intended that they should, to a great distance and supply a large number of translating devices. In such cases there is inevitably a difference in tension between various parts of the circuit, due to the resistance of the main conductors. This may be partially remedied by making the conductors very large near or at the station, gradually decreasing their size or conducting capacity; but such plan only lessens slightly the ratio of fall. To obviate the difficulty I provide feeding-conductors, which extend from the generator or generators to the main conductors of the lamp or consumption circuit or circuits, such feeding-conductors not having any translating devices connected therewith, and being connected with the main conductors of the consumption circuit or circuits at the center, ends, or other points on such main conductors. From a central station several sets of such feeding-conductors may run, each set feeding into its own lamp or consumption-circuit or all the sets feeding into a connected system of lamp or consumption circuits. It will be seen that the drop upon the feeding-conductors has no effect upon the relative candle-power of the lamps of the system, the relative candle-power of the lamps being affected only by the drop upon the main conductors of the consumption circuit or circuits between the end of a set of feeding-conductors and points most distant from any feeding-conductors. In order to maintain practically the same candle-power throughout the system, the main conductors of the consumption circuit or circuits should be so proportioned that the drop in tension upon them shall not exceed a definite small limit—for example, five per cent. This drop will make a difference of less than a candle-power in all the sixteen-candle-power lamps of the system, which difference is not perceptible to the eye. Upon the feeding-conductors, however, any loss can be made. This loss will be varied according to localities and the relative cost of copper for conducting purposes and horse-power for generation. This loss upon the feeding-conductors in large and extended systems will generally be greater than upon the main conductors of the consumption circuit or circuits. It may be, for example, about fifteen per cent.; but circumstances might make it desirable to diminish the loss upon the feeding-conductors down even as low as that upon the main conductors of the consumption circuit or circuits, or to increase the loss upon the feeders to more than fifteen per cent.

In this connection I wish to state that I am aware of the French patent of Khotinsky, No. 107,307, granted March 19, 1875.

When it is desired to use a few lamps near the central station they may be placed upon a direct circuit therefrom, with resistance at the commencement or home end of the circuit suf-

ficient to then reduce the tension of the current in such circuit so that it shall only be equal to that in the more distant circuits, and one or more of such circuits may be combined with the circuits before described. When large buildings or blocks of buildings using many lamps are to be supplied, it may be desirable to lay therefor separate feeders insulated from each other.

Where several central stations are used in a city, each having feeding-conductors leading to lamp-circuit conductors of the description before noted, it may be advisable to connect the feeding-circuits of all the stations, equalizing the tension or pressure throughout the entire system of the place where the central stations are located.

In the drawings are given diagrammatic representations of circuits, which will be more fully hereinafter described.

Figure 1 illustrates a plan wherein the conductors are made larger at their home ends, gradually tapering to the outer end of the system. Where such plan is used it is preferable to make the conductor a compound one, composed of several single wires of different lengths, one or two of which extend the whole length of the conductor, others ending at various points, as shown in Fig. 1^b. These wires are not insulated, but merely grouped in a bunch, which have transverse fastenings at intervals, or which may be fastened together by branch conductors passing around where connections are formed, as shown in Fig. 1^a. It is preferable to form all conductors which vary in size, decreasing from some point in this manner, and it is to be understood in subsequent descriptions that all such conductors are so made.

In Fig. 2 feeding-conductors 1 2 lead from central station C S, connecting with the lamp-circuit 3 4 at about its center, the conductors of the lamp-circuit being largest at that point, and also of slightly larger capacity at that point than the feeding-conductors. By this arrangement most of the fall of pressure or drop in tension takes place in the feeding-circuit, so that it cannot affect any lamps, while the drop in the lamp-circuit is reduced very low, as before explained, the drop from the center of the lamp-circuit to either terminal being only about one-fourth what the drop would be from *y* to *z* if either end were connected directly to the central station. Any desired number of lamp-circuits may be so arranged, each having its proper feeding-conductors, two so arranged being shown in Fig. 3.

In some instances where it is desired to use a few lamps near the station they may be placed directly upon main conductors, and combined with the circuits shown in Figs. 2 and 3, as shown in Fig. 4, where feeders 5 6 connect with lamp-circuit 9 10, arranged as in Figs. 2 and 3, while circuit 1 2, connected directly to C S, has a few lamps upon it, in which case resistances R R should be used therein to lessen the tension of the current in 1 2 to the same extent as it is lessened by the larger conductors 5 6. With such arrangement may also be combined an ordinary terminal circuit containing a few lamps, such as the circuit 13 14 in Fig. 5.

In Fig. 6 is shown direct or main feeding circuits 1 2 and 5 6 with lamp-circuits 3 4 and 9 10 with branch feeders 7 8, 15 16, and 21 22 leading into side streets, supplying lamp-circuits 17 18, 19 20, 23 24, and 25 26, the branch feeders being derived circuits from the main feeders, all constituting a multiple-arc system.

In Fig. 7 feeding-mains 1 2 connect to the center of the lamp-circuit 3 4, while feeders 5 6, leading to a greater distance and to a circuit when comparatively few lamps are required, connects to the end of lamp-circuit 9 10, whose conductors gradually taper from the point of connection. This arrangement is sometimes desirable in sparsely-settled localities, as involving economy in the laying of conductors.

In Fig. 8 is shown feeding-conductors 1 2, from which lead house-feeders *a b*, which connect to lamp-circuits *a′ b′*, which are of same description as circuit 3 4, Fig. 2.

Fig. 9 shows a series of houses or buildings, *c d e f*, to each of which leads a feeding-circuit of insulated conductor, the lamp-circuit of each house being thereby put in direct connection with the central station C S, the tension of the current in any one lamp-circuit not being affected by the others.

In Fig. 10 are two blocks of buildings, A and B, composed each of several houses, *h h h*, separate feeding-circuits 1 2 and 3 4 leading to branch feeding-circuits, from which lamp-circuits lead into each house, each house or lamp-circuit being provided with its own connection and meter.

In the arrangements shown in Figs. 8, 9, and 10 the greatest portion of the fall or drop occurs in the conductors leading to the house or block lamp-circuits, the tension or pressure in the branches leading into the houses being maintained practically uniform thereby in each lamp-circuit.

Fig. 11 shows a series of central stations, C S, from each of which lead main feeding-circuits M, which may be of any desired number, each connecting to and feeding into a lamp-circuit, *l c*. The mains of all the stations are connected by conductors *n n n*, so that all the stations are electrically connected into one general system, whereby the pressure throughout the entire system is equalized.

In Fig. 12 the lamp-circuit L C is fed by a number of feeding-circuits, connecting thereto on opposite sides, alternately 1 2, 3 4, and 5 6, forming three feeding-circuits, by which arrangement a comparatively uniform force or pressure may be maintained throughout the entire system.

I do not claim broadly a conductor tapering from the source of energy, as such, *per se*, is old; but I do claim, as hereinafter set forth, my particular way of forming such a conductor.

What I claim is—

1. A consumption-circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle-power of the lamps connected therewith, in combination with feeding-conductors connecting the consumption-circuit with the source of electrical energy, and having no translating devices connected therewith, the drop in tension upon such feeding-conductors not affecting the relative candle-power of the lamps of the consumption-circuit, substantially as set forth.

2. A consumption-circuit in the main conductors of which there is a definite small drop in tension not sufficient to vary practically the candle-power of the lamps connected therewith, in combination with feeding-conductors connecting the consumption-circuit with the source of electrical energy, and having no translating devices connected therewith, the loss upon such feeding-conductors being greater than upon the main conductors of the consumption-circuit, substantially as set forth.

3. The combination of a consumption-circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle-power of the lamps connected therewith, with a feeding-circuit having no translating devices, and extending from the source of electrical energy to the center of the consumption-circuit, substantially as set forth.

4. The combination of two or more central stations having feeding-conductors, and consumption-circuits supplied by such feeding-conductors, as described, of connections between the conductors of the central stations, substantially as and for the purposes set forth.

5. The combination, in one system, of a main circuit connected directly to a source of energy, and containing translating devices, and provided with resistances for lessening the tension or pressure of the current to that of the average of the system, a circuit not directly connected to the source of energy containing translating devices, and a feeding-circuit connecting the latter circuit with the source of energy, substantially as set forth.

6. The combination of a number of uninsulated wires of different lengths grouped together and fastened at intervals, forming a gradually-tapering conductor, substantially as set forth.

This specification signed and witnessed this 4th day of August, 1880.

THOS. A. EDISON.

Witnesses:
WM. CARMAN,
OTTO A. MOSES.

2 Sheets—Sheet 1.

T. A. EDISON.

MAGNETO ELECTRIC MACHINE.

No. 264,643. Patented Sept. 19, 1882.

Fig. 2.

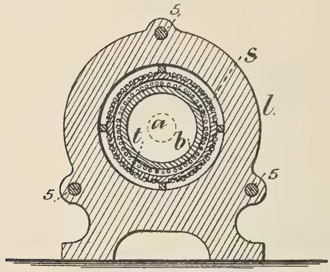


Fig. 4.

Fig. 6.

Fig. 1.

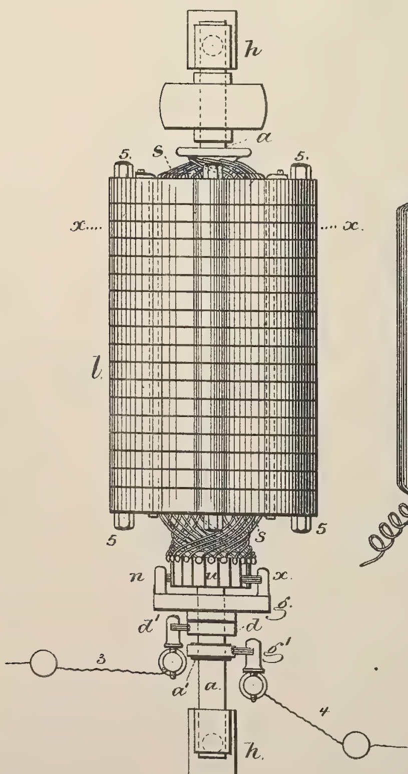


Fig. 3.

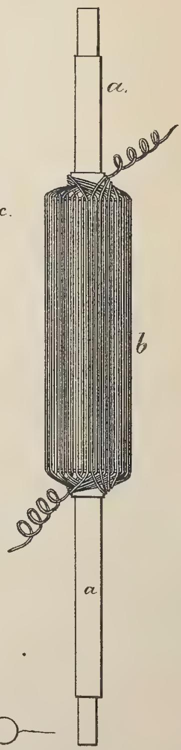


Fig. 5.

Witnesses
Harold Serrell
Geo. T. Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
Atty

N. PETERS, Photo-Lithographer, Washington, D. C.

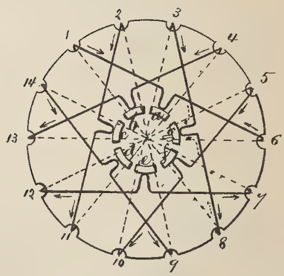
2 Sheets—Sheet 2.

T. A. EDISON.

MAGNETO ELECTRIC MACHINE.

No. 264,643. Patented Sept. 19, 1882.

Fig. 7.



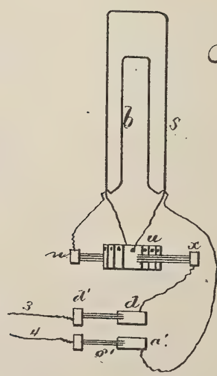


Fig 8

Witnesses/
Harold Serrell
Geo T. Pinckney

Inventor
Thomas A Edison
per Lemuel W. Serrell
atty

N. PETERS. Photo-Lithographer. Washington. D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MAGNETO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 264,643, dated September 19, 1882.

Application filed May 12, 1879. Patented in Belgium June 16, 1879, No. 48,341; in England June 17, 1879, No. 2,402; in Italy June 23, 1879; in Victoria August 16, 1879, No. 2,685; in France August 25, 1879, No. 130,910; in Sweden September 24, 1879; in Spain October 4 1879; in Norway January 20, 1880; in Austria-Hungary January 22, 1880; in Denmark June 11, 1880, and in Germany February 7, 1881, No. 12,033.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Magneto-Electric Machines, (Case No. 177,) of which the following is a specification.

In this machine I employ a cylinder the surface of which is covered with a coil of wire wound around it lengthwise and parallel to the axis of rotation. The electric current, passing through the coil, converts the cylinder into a magnet. One side of the cylinder is of north polarity and the opposite side is of south polarity. A shell of iron is employed, within which this magnetic cylinder is revolved, and by induction the shell becomes magnetized. Hence the magnetic forces in the shell revolve around the same in harmony with the revolving magnetic cylinder.

There is a space between the revolving magnetic cylinder and the inside of the shell, within which space there are longitudinal wires connected in a peculiar manner to the commutator, and in the wires an induced current is set up in consequence of the revolving magnetic forces crossing and cutting these wires as the magnetic cylinder revolves within the shell, and from the commutator the current is taken to the line-wires.

In the drawings, Figure 1 is a plan of the magneto-electric machine complete. Fig. 2 is a cross-section of the same at the line *x x*. Fig. 3 is a plan of the revolving field-magnet. Fig. 4 is an end view of the same. Fig. 5 is a plan of the shell surrounding the field-magnet and the induction-coil. Fig. 6 is an end view of the same. Fig. 7 is a diagram showing the manner of winding the induction-coil, and Fig. 8 is a diagram of the circuit-connections.

The shaft *a* is provided with a cylinder, *b*, of iron. It may be either solid or hollow and made of cast-iron or coiled iron wire. The same is wound with a parallel coil of insulated wire, the wire passing from the shaft radially, then along one side of the cylinder, across the other end, back again on the other side and across the end, and so on until the entire surface of the cylinder is covered with wires that are parallel, or nearly so, to the axis of the cylinder. One end of this insulated wire passes along the shaft in a groove to the insulated ring *a′* and the other is connected to the commutator spring or brush *n*, that is insulated upon a disk, *g*, affixed to and rotating with the shaft *a*. The other commutator-spring, *x*, is connected to the ring *d* upon the shaft *a*. The spring *d′* rests against the ring *d*, and to it the line-wire 3 is connected, and the spring *g′* rests against the ring *a′*, and to it the ground or return wire 4 is connected, or vice versa.

It is to be understood that this magneto-electric machine may be employed in a circuit containing electric lights, or any other instrument or device operated by electricity to which the current generated may be adapted.

The shaft *a* is mounted in bearings or a frame, *h*, and revolved by competent power. the shell *l* is made of coiled iron wire or of iron rings secured together by bolts 5; and between the rings there are sheets of paper or other insulating material to separate the rings and prevent the magnetic currents circulating in the direction of the axis of rotation; but the rings are each magnetized by induction from the magnetic cylinder *b*, and the lines of magnetic force radiate from the cylinder to the rings, and as the cylinder *b* revolves within the shell, these lines of magnetic force are moving around rapidly with the magnetic cylinder.

In magneto-electric machines the most potential currents are set up in wires that are moved across the lines of magnetic force. I therefore place longitudinal wires in the space between the revolving magnetic cylinder and the shell, so that such wires are crossed by the lines of magnetic force as the same revolve.

The induction-coil is composed of the parallel wires *s* upon the surface of the thin cylinder *t*. Such wires cross the end of the cylinder *t* at the opposite end to where the commutator-bars *u* are placed, and at the commutator such wires are united to the circular range of bars *u*, that are insulated, and upon which the springs *n* and *x* rest.

The wire of the parallel induction-helix is

substantially endless, and it is wound with reference to obtaining a continuous current. The diagram, Fig. 7, illustrates the manner of winding the wires. The number of parallel coils may be more or less than that shown; but I find the object desired can be attained the best by using an even number of parallel coils longitudinally of the case and an odd number of commutator-plates. The current set up in coils within the magnetic field of the north pole will be all in one direction, and the currents set up in the coils within the field of the south pole will be all in the other direction. I wind the wires in such a manner that, while the wire is continuous and the current flowing through the whole of it, the current will pass by two wires of the induction-coil to one commutator-plate and then away, and will enter by an opposite commutator-plate and pass by two wires out into the coil and circulate through the same to the other commutator-plate. Suppose the springs to rest upon commutator-plates *a* and *e*. The current will flow toward *a* from wires 1 and 6 and away from *e* by wires 12 and 7. By following the arrows it will be found that the entire coil is a complete circuit, in which the parallel portions of the wires in the south field of magnetic influence have a current energized in one direction and in the north field in the other direction, thus obtaining the dynamic effect, and there is no break or pulsation of the current. The springs touch one commutator before leaving another.

Of course the current is reversed in the parallel portions of the wires successively. For instance, the current in 7 and 14 is reversed as the magnets and brushes travel around together. As the spring passes from *e* to *d* the current in 14 is reversed and passes out from *d* by 14 and to 7 in the reverse direction and to 12, as before. As the spring passes from *a* to *g* the current in 8 and 7 is reversed. It passes from 6, as before, and, crossing, is reversed in 1, and, returning in 8 in opposite direction, is taken off by *g*. The dotted arrows indicate these successive changes of direction, whereby the currents are made to flow by two wires to each commutator in succession from the entire magnetic field. The current will flow from spring *g′* through *a′*, thence through the parallel coils of wires around the cylinder *b* to the commutator *n*, thence by the bar upon which it rests along the parallel induction-coil at one side of the cylinder *t*, returning along the other side to the commutator-bar and by the spring *x* to the ring *d* and spring *d′* to the line.

It is to be borne in mind that the parallel induction-coil *s*, cylinder *b*, and commutator-bars *u* remain stationary and the commutator-springs *n x* revolve around the bars *u*, being turned by the shaft *a*, and the commutator-springs are to be located with reference to the revolving magnetic cylinder, so as to take off the current at the place of greatest energy. The current will be continuous, or nearly so, and travel in one direction. There will, however, sometimes be a spark between the commutator-bars when the circuit of the parallel induction-coil is interrupted; but this will be lessened by having the commutator-springs bent to rest on more than one commutator-bar.

It will be apparent that the shell and parallel induction-coil may be revolved if the magnetic cylinder remains stationary or revolves in the opposite direction; and I remark that the cylinder supporting the parallel induction-coil *s* may be of any suitable material; but I prefer and use vulcanized fiber.

The parts of this machine are not liable to become heated under ordinary circumstances of use, because the wires are not wound one on the other, and the atmosphere has an opportunity to circulate. I however apply a fan in some instances upon the shaft *a* within a case communicating with the internal portions of the machine, so as to induce a current of air through the same.

I claim as my invention—

1. The cylinder *b*, serving as a field-magnet and wound with a continuous wire for producing magnetic poles on opposite sides of the cylinder, substantially as set forth.

2. The combination of a cylinder wound with a continuous wire and serving as a field magnet, an inductive coil concentric thereto, consisting of a single layer of wire and an inclosing magnetic case, substantially as set forth.

Signed by me this 21st day of April, A. D. 1879.

THOMAS A. EDISON.

Witnesses:
STOCKTON L. GRIFFIN,
WM. CARMAN.

(No Model.)

T. A. EDISON.

SYSTEM OF CONDUCTORS FOR THE DISTRIBUTION OF ELECTRICITY.

No. 264,645. Patented Sept. 19, 1882.

Fig. 1.

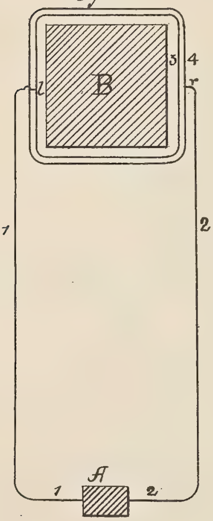


Fig. 2.

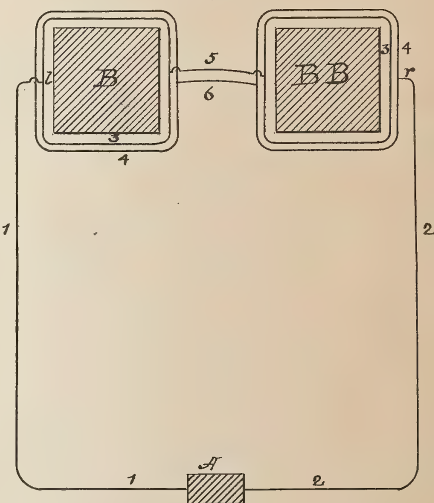


Fig. 4

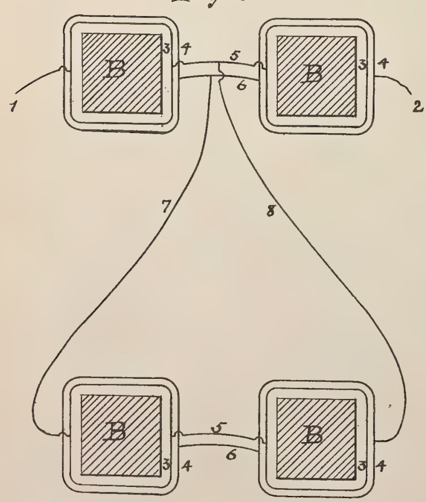
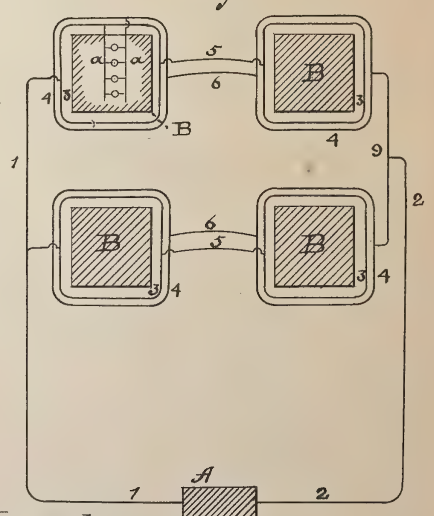


Fig. 3.



Witnesses.

Chas. Raettig.

J. D. Mott

Inventor:

T. A. Edison.

per Dyer & Wilber

Attorneys.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

SYSTEM OF CONDUCTORS FOR THE DISTRIBUTION OF ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 264,645, dated September 19, 1882.

Application filed October 7, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful System of Conductors for the Distribution of Electricity, (Case No. 247;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In my Patent No. 239,147, dated March 23, 1881, is set out the necessity in systems of distributing electricity for conversion into heat and power of the maintenance of an equal pressure or electro-motive force throughout the system, and in such patent is shown a system of laying conductors having this object in view. The invention in this case relates to the same object, and is intended to furnish a system which shall accomplish the same result. In this case two conductors, forming a complete metallic circuit, are laid entirely around each square or block as the service-conductors of such block. Feeding-conductors from the source of electricity lead to and connect with the service-conductors, but upon opposite sides—that is, one conductor (say the one from the + pole) connects at some point to one service-conductor of a block, while the one from the − pole connects to the other service-conductor at a point exactly opposite to the other, so that the terminals of all house-circuits of a block, or the points where the house-circuits connect to the service-conductors, all have the same mass of conductors between them and the central station. A series of blocks may be so arranged, the feeding-conductors leading to the extreme or opposite blocks, one to each of the series, the service-conductors of the blocks being united by cross-conductors, so that each block is distant electrically from the source by the same mass of conductor.

In the drawings, Figures 1, 2, 3, and 4 are diagrams illustrating such system or arrangement of conductors.

A is the central station, at which is located a suitable source of electricity, and from which lead feeding-conductors 1 2.

B represents a block or square, around which are laid the service-conductors 3 4. Conductor 1 leads to 3 at l upon one side of the block, while 2 leads to 4 at r upon the opposite side of the block. The greater portion of any fall of electro-motive force will occur in conductors 1 2, while it will be constant at all points in the service-conductors 3 4, because every point in such conductors is distant from the source by exactly the same mass of conductor, as is evident from inspection of the diagram.

In Fig. 2 two blocks, B and B B, are shown, conductor 1 leading to and connecting with 3 of block B, while 2 leads to and connects with 4 of B B, while cross-conductors 5 6 connect the conductors of the blocks.

In Fig. 3 four blocks are shown, conductor 2 being connected to 4 of the right-hand blocks through a branch, 9, leading to both right-hand blocks, while 1 connects directly to both left-hand blocks. In this figure is shown a house-circuit, a a, containing lamps (indicated by o o) placed between a a.

In Fig. 4 two blocks are connected, as in Fig. 2, while from the cross-conductors 5 6 leads a derived circuit, 7 8, leading to two other blocks arranged as described.

Instead of two blocks, as in Fig. 2, any number may be used.

In all these plans each block and each house-circuit are electrically equidistant from the source, by which uniformity and equality therein are attained, the loss or drop of force occurring in the feeding-circuits.

What I claim is—

In a system of electrical distribution, the combination, with positive and negative service-conductors laid entirely around each block of a district, of feeding-conductors, each connected with one of said positive and negative conductors at points on opposite sides of each block electrically equidistant from the central station, substantially as set forth.

This specification signed and witnessed this 1st day of September, 1880.

THOS. A. EDISON.

Witnesses:
W. CARMAN,
S. MOTT.

(No Model.)

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 264,646. Patented Sept. 19, 1882.

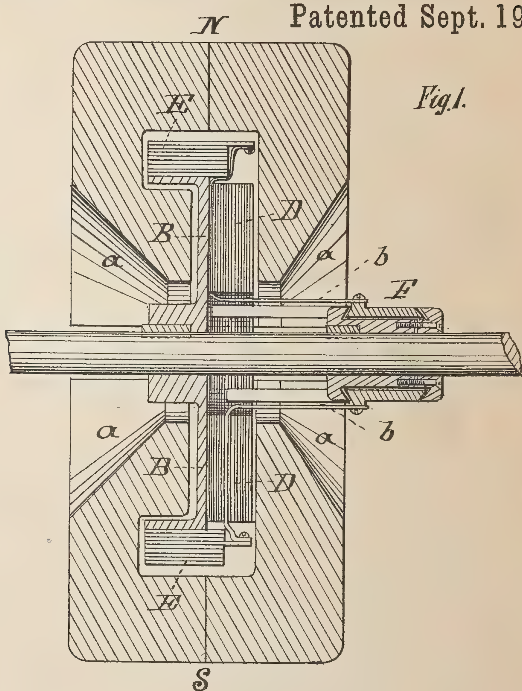


Fig. 1.

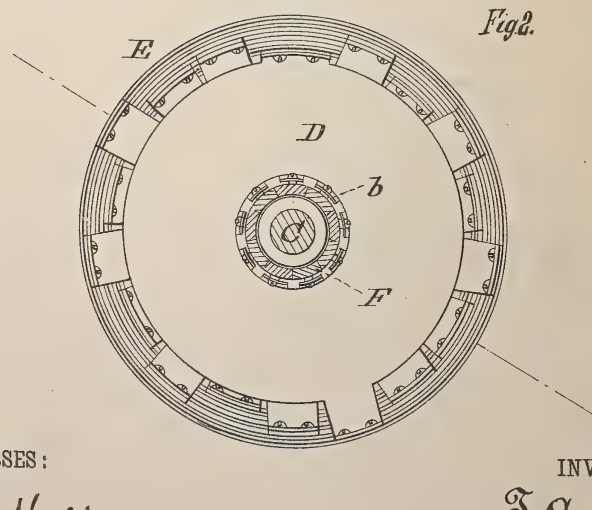


Fig. 2.

WITNESSES:

O. D. Mott
J. Ellis Clark.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 264,646, dated September 19, 1882.

Application filed November 28, 1881. Renewed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 362;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce another form of dynamo or magneto electric machine or electric engine having disks of copper for the inductive or conducting portion of the armature.

In carrying out my invention a series of copper disks insulated from each other are secured to one side of a cast-iron plate or disk which forms the magnetic portion or core of the armature. The copper disks and iron plate revolve together in chambers in the opposite polar extensions of an exciting-magnet, such polar extensions being beveled on their approaching sides, so that intense magnetic fields will be formed between the polar extensions and opposite portions of the iron plate, and but little force will be expended directly across between the poles of the magnet. The currents generated in each disk in the opposite fields of force flow in the same direction, and the disks being all on one side of the iron plate their currents all flow the same way. To connect up such disks so as to produce a continuous current having a tension due to all the disks, exterior copper rings are used which couple the disks in series. The disks are connected with the bars of the commutator-cylinder by rods or plates passing to projections in central openings of the disks, or to the exterior ring-connections.

The foregoing will be better understood from the drawings, in which Figure 1 is a vertical section through the armature and the polar extensions of the exciting-magnet; Fig. 2, a separate elevation of the armature from the commutator end, the commutator-cylinder being in vertical section.

N S are the polar extensions of the exciting-magnet, chambered or hollowed out, as shown, to inclose opposite portions of the armature, and having beveled sides *a*, so as to reduce the width of its approaching faces and reduce the attractive force acting directly across between the polar extensions. The armature has a cast-iron plate or disk, B, mounted upon a shaft, C. Secured to one side of this iron plate by bolts or otherwise are a number of copper disks, D, which are insulated from each other and from the iron plate, preferably by means of paper disks. A number of copper rings or segments of rings, E, are supported by the rim of plate B and connect the copper disks in a continuous series. The disks are connected with the bars of commutator-cylinder F by strips or rods *b* extending from the open centers of the disks to such commutator-bars.

What I claim is—

1. A dynamo or magneto electric machine having inductive disks located on one side only of a plate of magnetic metal, substantially as set forth.

2. The armature having inductive disks, in combination with exterior rings for connecting such disks in series, substantially as set forth.

3. The combination, with the exciting-magnet having chambered polar extensions, of the revolving armature having a plate of magnetic metal, inductive disks on one side thereof, rings for connecting the disks in series, and commutator-connections, substantially as set forth.

This specification signed and witnessed this 25th day of October, 1881.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,
H. W. SEELY.

(No Model.)

2 Sheets—Sheet 1.

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 264,647. Patented Sept. 19, 1882.

Fig. 1.

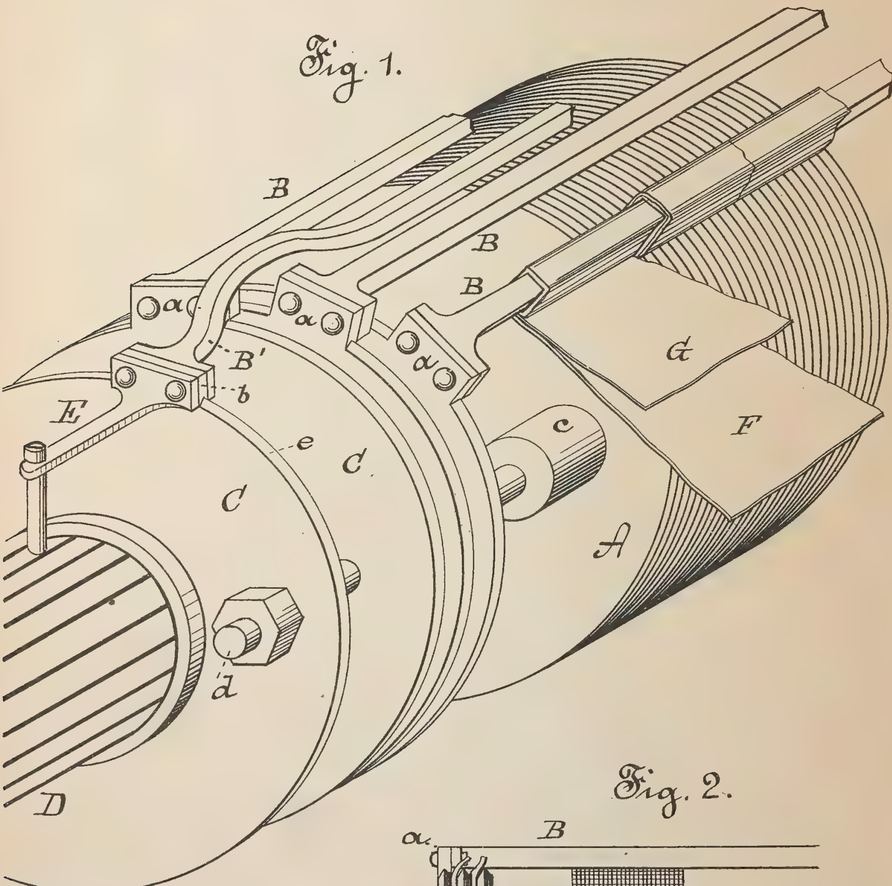
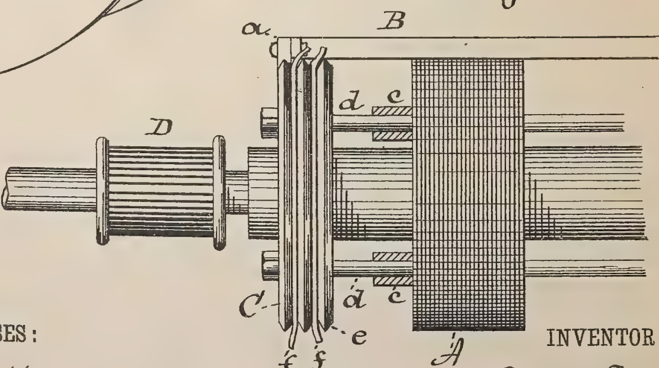


Fig. 2.



WITNESSES:

O. D. Mott

M. J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS

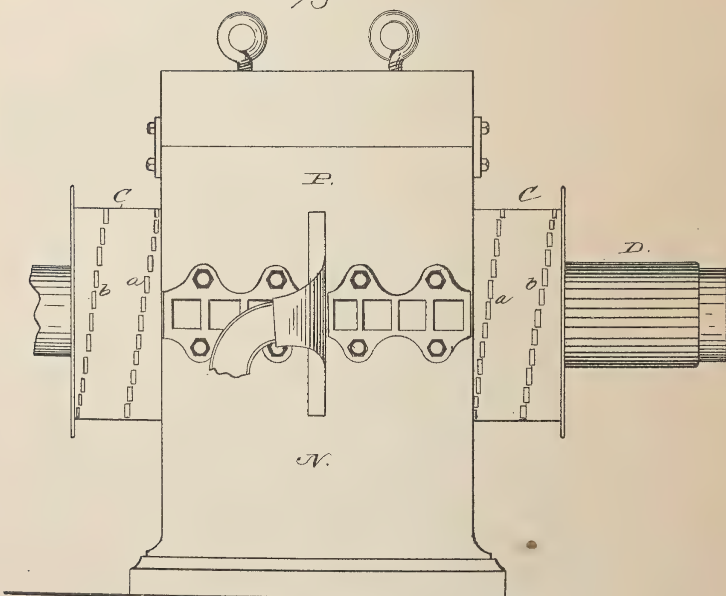
(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 264,647. Patented Sept. 19, 1882.

Fig. 3.



WITNESSES:

Edw. C. Rowland
N. A. Clark

INVENTOR:

Thomas A. Edison
By Richd N. Dyer
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 264,647, dated September 19, 1882.

Application filed October 4, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 347;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce such improvements upon my dynamo or magneto electric machine wherein are employed inductive bars running lengthwise of the armature and connected at their ends by disks that a better connection between the ends of the bars and the disks will be formed, so as to prevent heating at those points; the connections between the disks and the commutator-bars will have a larger conducting area and be more rigid than in constructions previously employed by me, in order to prevent the heating of such connections, and also to prevent their breakage by abrasion; the contacts of bars and rods with disks will be reduced in resistance and prevented from oxidizing; the copper disks for connecting the ends of the bars will be located outside of the field of force, or nearly so, and will not be heated by the circulation of currents induced in them when the circuit is open at the commutator by movement in the magnetic field; means will be provided for preventing electrical creeping between the edges of the copper disks; and, finally, the copper inductive bars will be so insulated that the insulation cannot be pierced by electricity, and at the same time the heat will be conducted off and not allowed to accumulate in the bars.

In my dynamo or magneto electric machines the copper bars are connected at their ends to bars or lugs on copper disks insulated from each other, which bars are arranged in a spiral line extending twice, or nearly so, around the circumference of the cylinder formed by the disks at each end of the armature. Heretofore I have made these ears of the same size as the unenlarged ends of the copper bars and have separated them the width of the bar, every alternate bar passing between two ears of the first line to an ear of the second line. By my present invention these ears are widened so as to close up the spaces between them, and the copper bars are provided with T-shaped ends, which are secured to said ears. The alternate bars are curved outwardly so as to pass over the first line of ears, and inwardly again to make connection with ears of the second line. This construction provides a larger contact between the bars and disks. To lessen the resistance of this contact and prevent oxidation I plate the surfaces with gold or silver, or amalgamate them with mercury; or I may first plate with silver and then amalgamate the surfaces. It is desirable to do this because the resistance of a contact between two copper surfaces is very great to begin with, and as such surfaces are very liable to oxidation such resistance will continually become greater. A gold, silver, or mercury contact, however, is one of low resistance, oxidizes less rapidly, and is less susceptible to outside influences, gold being especially preferable for these reasons to the other metals mentioned. In addition, to give strength and a large conducting area, I use washers, which are placed on the outside of the ears, and are secured by the same bolts that pass through the ears and the ends of bars. The broadened or T-shaped bars could also be used in the armature shown in my Patent No. 242,898, of June 14, 1881, in which the ends of the bars are secured in notches at the ends of radial plates, or in other armatures having connecting-plates, the term "plate" being intended to include both entire disks and segmental or radial plates.

For commutator-connections I dispense with the tongues heretofore used by me, and extending from the open centers of disks to the commutator-bars, and employ instead thereof exterior rods, which have the same, or nearly the same, conducting area as the inductive bars. These rods have T-shaped ends, and are secured to alternate ears of the disks by the same bolts that secure the inductive bars thereto. This gives one commutator-connection for each disk of great strength and low resistance. The rods that are secured to ears of the inner line are curved outwardly to avoid the ears of the second line. The surface-contacts of these rods and the ears are also plated with gold or silver or amalgamated, or plated with silver and then amalgamated.

To secure the benefits of locating the copper disks outside of the field of force, or nearly so,

I place thimbles upon the bolts which secure the disks to the armature-core, which thimbles are situated between the core and disks and separate the disks a certain distance from the core. Since the polar extensions of the exciting magnet or magnets terminate at the ends of the armature-core, the copper disks will be wholly outside of such polar extensions, and consequently outside of the magnetic field, or nearly so. An air-space is also formed between each end of the armature-core and the disks by this construction, through which space air circulates and serves to conduct off heat generated in the parts.

To prevent electrical creeping between the edges of the copper disks, such disks are beveled on both sides at their edges, and the paper sheets which are used to insulate the copper disks from each other are extended a short distance beyond the edges of the disks, and are pressed down into the angular spaces formed by the beveled edges.

For insulating the copper inductive bars I wrap them with parchment-paper. The parchment-paper I find is not only a good insulator, but is also a good conductor of heat, on account of its compactness, and is tough and durable and otherwise well adapted for the purpose. Ordinary paper or other fibrous material having its pores filled with a sizing or varnish, so as to be a fair conductor of heat, I consider the equivalent of the parchment-paper. I prefer to use in connection with the wrapping of parchment-paper a layer of mica, which is wrapped with the parchment-paper, being held by the same and prevented from breaking into pieces and falling from place. Mica is also a good conductor of heat, as well as being a good insulator of electricity, and forms with the holding wrapping of parchment-paper an exceedingly efficient heat-conducting insulation for the inductive bars, although the parchment-paper may be used without the mica. The bars may also be japanned or covered with rubber, which is afterward vulcanized.

The foregoing will be better understood by reference to the drawings, in which Figure 1 is a perspective view from the commutator end of my machine, showing a few of the parts separated for clear illustration; Fig. 2, a side elevation of some of the parts at the commutator end of the armature; and Fig. 3, a side elevation of the main parts of the machine, the bars being removed from the armature.

A is the core of the armature.

B B′ are the copper inductive bars, extending longitudinally along the core A, and connected at their ends to copper disks C, insulated from each other. The bars B extend straight to the ears *a* of the disks, while the alternate bars B′ are curved over the first line of ears to ears *b* of the second line.

D is the commutator, and E represents the rods, extending from alternate ears to the bars of the commutator. The contacts of B and B′ and of E with the ears of disks C are plated or amalgamated, or both, as before described.

The thimbles *c* on bolts *d* separate the disks C from the ends of the core A to bring such disks outside of the polar extensions of the machine and remove them as far as practical from the effects of the magnetic field. The copper disks C have double-beveled edges *e*, forming angular spaces, into which the projecting edges of paper sheets *f* are pressed to prevent electrical creeping between the edges of disks.

F is the insulating wrapping of parchment-paper, and G the mica.

In Fig. 3, P N represent the polar extensions of the field-magnet of the machine, outside of which are the copper disks C, having the double spiral line of ears *a b*.

What I claim is—

1. In an armature for dynamo or magneto electric machines consisting of bars forming the inductive coils and connecting-plates, the combination, with such plates, of the inductive bars having enlarged ends for forming connection therewith, substantially as set forth.

2. In a dynamo or magneto electric machine, the combination of the disks having a double spiral line of projecting ears with the inductive bars connected with such ears, the alternate bars being curved outwardly to avoid the first line of ears, substantially as set forth.

3. In a dynamo or magneto electric machine having cross connecting disks, the combination, with said disks, of the outside rods connecting them with the commutator, substantially as set forth.

4. In a dynamo or magneto electric machine, the combination of the inductive bars and the disks having projecting ears with the outside rods extending from alternate ears to the commutator-bars, substantially as set forth.

5. In a dynamo or magneto electric machine, the combination, with the armature-core, of the cross connecting disks located outside of the magnetic field, substantially as set forth.

6. In a dynamo or magneto electric machine, the combination, with the armature-core, of the cross connecting disks separated from the ends of such core, leaving air-spaces and removing disks from magnetic field, substantially as set forth.

7. In a dynamo or magneto electric machine, the cross connecting disks having beveled edges, in combination with intermediate insulation, substantially as set forth.

8. In a dynamo or magneto electric machine, the copper inductive bars wrapped with parchment-paper, substantially as set forth.

9. In a dynamo or magneto electric machine, the copper inductive bars having an insulation of mica and parchment-paper, substantially as set forth.

This specification signed and witnessed this 24th day of August, 1881.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 264,648. Patented Sept. 19, 1882.

Fig. 1.

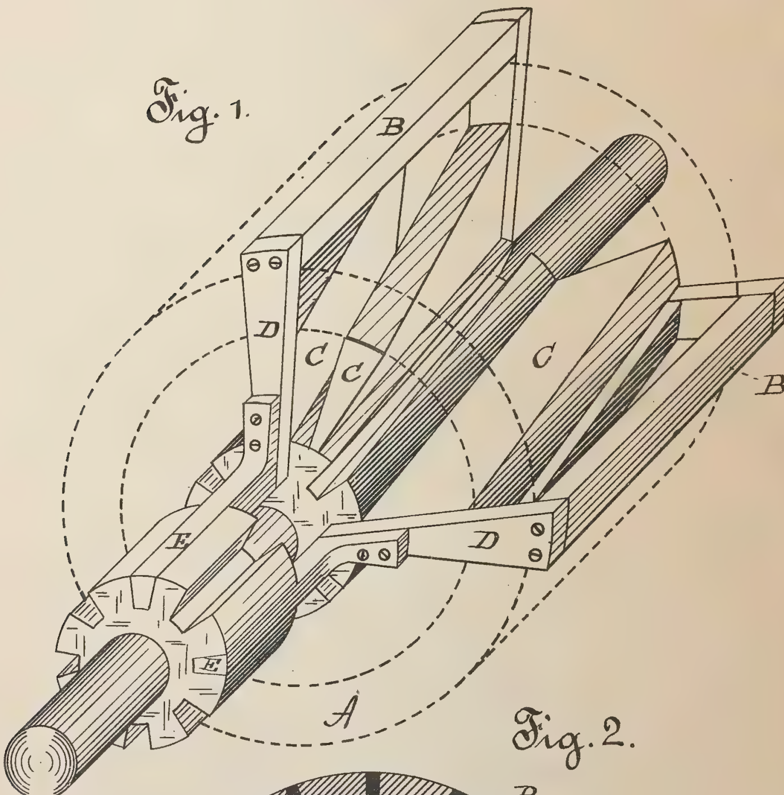
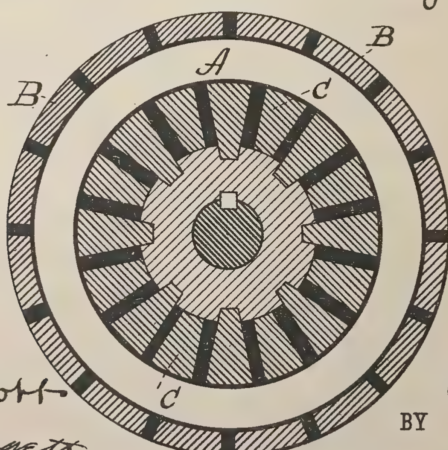


Fig. 2.



WITNESSES:

S. D. Mott

W. J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 264,648, dated September 19, 1882.

Application filed November 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 351;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is such an improvement upon electrical generators and engines of the Pacinotti type that the inactive portions of the bobbin will have an exceedingly low resistance, so that the internal resistance of the machine will be reduced to the minimum. This I accomplish by forming the bobbin-coils of bars which extend on the outside of the ring parallel with the axis of rotation, and of plates on the inside of the ring, the bars and plates being connected to produce a continuous bobbin by radial end bars. The alternate bars or coils are connected with commutator-bars. The plates which are the main inactive portion of the bobbin have a very low resistance.

In the drawings, Figure 1 is a perspective view of a portion of the armature of my machine, and Fig. 2 a cross-section of the armature.

A is the ring of the armature.

B represents the exterior bars.

C represents the interior plates, which are preferably beveled, as shown, and are placed at an angle to the axis of rotation in order to form, with the exterior bars, B, and radial end bars, D, a continuous bobbin. The alternate bars D at one end of the armature are connected with bars E, which form or are connected with the bars of the commutator-cylinder.

Each exterior bar, A, may be made in one piece, with the two radial bars D at its ends, and the commutator-bars E may be formed by bending the ends of the proper bars D outwardly.

What I claim is—

1. The combination, with the annular core, of the exterior bars, the radial end bars, and the interior plates, substantially as set forth.

2. The combination, with the annular core, of the exterior inductive bars, the radial end bars, commutator-connections extending from such end bars, and the interior beveled plates, of lower resistance than the exterior inductive bars, substantially as set forth.

This specification signed and witnessed this 23d day of September, 1881.

THOS. A. EDISON.

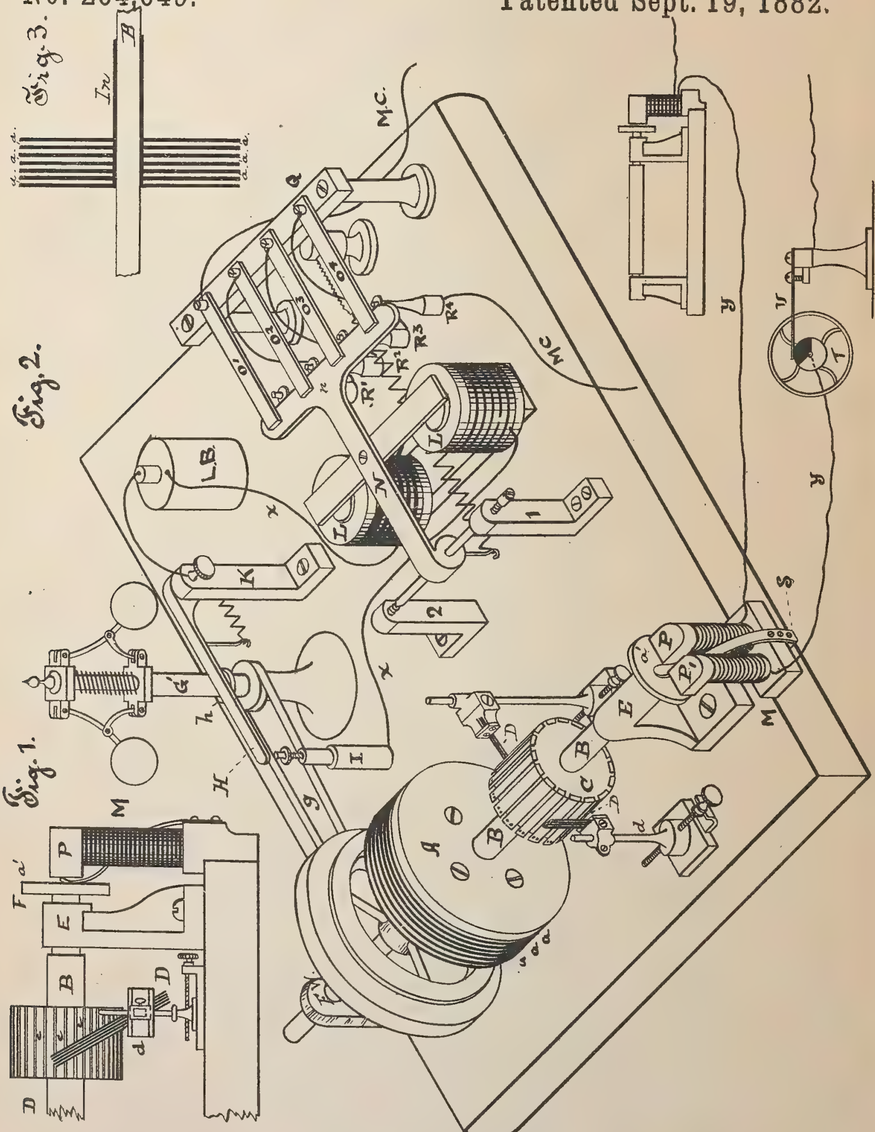
Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 264,649. Patented Sept. 19, 1882.



Attest:—

S. D. Mott
James A. Payne.

Inventor:—

T. A. Edison per
Dyer & Wilber
Attys

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 264,649, dated September 19, 1882.

Application filed March 20, 1880. (No model.) Patented in England April 5, 1880, No. 1,385; in Canada October 9, 1880, No. 11,857; in Italy October 12, 1880; in Belgium October 15, 1880, No. 52,698; in Victoria November 17, 1880, No. 2,926; in France November 27, 1880, No. 138,941; in Austria December 24, 1880; in New South Wales January 19, 1881; in Queensland February 7, 1881; in Spain February 21, 1881; in New Zealand March 7, 1881, No. 511; in Portugal March 31, 1881, No. 660, and in India April 12, 1881, No. 278.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines and Electric Motors, (Case No. 208;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

A portion of my invention relates to improvements in the rotating armatures, the arrangements of the commutator brushes or contacts, and the shaft of the rotating armature and commutator, which are applicable to both dynamo or magneto electric machines and to electric motors.

In rotating armatures made of a solid mass of metal, or of several large rings of metal, currents are induced in the armature itself, which circulate from points of greatest to those of lowest potential. To such currents is largely due the heating of the armature, so often an injurious element in such armatures. To remedy this I construct an armature of a number of very thin disks or rings secured together upon a proper shaft or base and slightly insulated from each other by sheets of tissue-paper. As currents induced in the rotating armature have very small electro-motive force, the insulation of the tissue-paper and the thinness of the plates prevent almost, if not quite entirely, the circulation of induced currents and the heating attendant thereon. By this the effective capacity of the machine for conversion is very largely increased, for while the heating at one moment is not large the covering of the armature prevents radiation and the accumulation of heat proceeds faster than its dissipation, and the armature becomes an accumulating-reservoir of heat, until the capacity of the machine for conversion is much impaired by limitation of exterior energy due to this heating, all of which is obviated by this use of exceedingly thin plates or disks. In this connection, as the word "thin" is a relative one, it is well to state that the plates should be, at most, not more than an eighth of an inch thick, and preferably very much thinner, and insulated from each other in order to attain these effects. I do not claim herein this peculiar construction of the armature-core, since it will be made the subject-matter of a separate application for patent.

Commutator springs or brushes have always been arranged at right angles to the axis of the commutator. With such there has usually been a large amount of "spark" on the face of the commutators, indicating a loss of electric energy by its conversion at a point where conversion was not only unneeded but injurious, causing a rapid destruction of the commutator apparatus. I find that this can be largely and usually entirely avoided by arranging the commutator springs or brushes so that their axial line is at an angle other than a right angle with the axis of the commutators, or, in other words, that the brushes or springs bear obliquely upon the face of the commutator. In practice I have found that it is better that the brushes or springs stand at an angle of about thirty degrees to the axis of the commutator. As ordinarily arranged, the brushes or springs travel over the face of the commutator in a uniform track, speedily wearing a groove therein, rendering the face of the commutator uneven. To remedy this, insuring even wear over the whole surface of the commutator, I arrange the shaft of the commutator and its bearings so that the shaft may have a longitudinal movement in the bearings. Upon the outer end of the shaft a disk is fixed, forming a circular armature to an electro-magnet suitably attached to the frame of the machine. When this magnet is charged, attracting the armature, the shaft is moved in one direction to its limit of motion, a spring serving to force it to the other limit when the magnet is inactive.

Attached to any rotating part of the apparatus is a disk, a portion of whose periphery is of insulating material, the remainder being a conductor; or the disk may have several alternat-

ing conducting and non-conducting portions. Upon the disk bears a contact-spring, the disk and spring being interposed in a circuit leading from a battery or other source of electricity to the magnet last spoken of, or the current therefor through a shunt may be a portion of the current of the machine itself. One rotating disk and spring may be arranged to control the circuit of the shaft-moving magnets of a large number of machines or motors.

In providing electromotors for any given work it is desirable that any one motor should be constructed to give the maximum power required with a certain definite current. As is the case with all motors, however, it may be desired to use the motor for less than its maximum capacity—that is, to run it with a variable load or amount of work to be performed. It is preferable that it should be provided with a governor to correct any fluctuations in speed consequent upon such variation in load or work. To accomplish this I place on the main shaft, or I gear to it either directly or by belting, a centrifugal governor, which lifts, upon too great speed, an adjustable circuit-lever, controlling by either making or breaking directly or indirectly the circuit to the motor. This lever may control directly the circuit to the motor passing through it, or it may control indirectly by controlling a local-battery circuit to a magnet whose armature-lever operates a circuit-breaker placed in the motor-circuit.

In order to prevent too sudden fluctuations upon the breakage of circuit, and to maintain regularity while the current is on, the main shaft is provided with a heavy fly or balance wheel whose momentum prevents irregularities and causes gradual slowing down when the circuit is broken. As the circuit-controlling lever of the governor completes the circuit through an adjustable stop, the joint effects of the governor and fly-wheel are that the machine is capable of the finest adjustment, breaking and completing the circuit upon the least variation from a determined desired speed, acting exactly, so to speak, as an automatic cut-off in steam-engines, preventing unnecessary consumption of energy. The breaking of the main circuit occasions a large spark at the breaking-point, which is more destructive as a unit than it would be if divided into several sparks. Hence I break the main circuit, when breakage is necessary, at several points simultaneously, in order to divide the spark and lessen its total injurious effect. I accomplish this by fixing upon an insulating-base several contact-springs, the free ends of which rest, each respectively, upon proper contact-posts and project slightly beyond the same. The circuit is led to one post, passes to its spring, whence it passes by a wire to the next post, into its spring, by wire to next post, and so on through the series of springs and posts. Either the circuit-controlling lever or the armature-lever, as either is used for the purpose, as before explained, is broadened at the end, so as to take under the extreme free ends of all the circuit-springs, and upon desired movement lift them all simultaneously from their posts, breaking the main circuit at a number of points.

In the drawings, Figure 1 is a detailed view of several parts detached from Fig. 2, which is an isometric view of a machine embodying the improvements which form the invention herein claimed. Fig. 3 is a sectional view of part of the armature-core.

A is the rotating armature-core divested of its external winding, which revolves between polar extensions of magnets, not necessary to be shown. This armature is composed of a number of thin plates, rings, or disks secured upon the shaft B, thin pieces of insulating material, preferably tissue-paper, alternating with the plates, rings, or disks, and separating each of them from all the others. The black lines *a a* show the metallic plates, the intermediate white lines representing the insulating material. The plates, disks, or rings should not exceed one-eighth of an inch in thickness, while the best results are obtained when the thickness is from one sixty-fourth to one thirty-second of an inch.

D D are the commutator brushes or springs, secured in stands *d*, capable of horizontal and vertical adjustment, as shown. As more clearly shown in Fig. 1, the springs or brushes are placed obliquely to the axis of the commutator, preferably at an angle of about thirty degrees. The shaft B of the revolving armature and of the commutator is supported in boxes E, and is arranged to have a longitudinal movement therein. Upon the end of the shaft B is fixed a disk, a', which forms the armature for a magnet, M, whose poles P P′ are extended, as shown, to exert their influence upon a'. Through the magnet passes an electrical circuit, *y y*, in which is placed a circuit-interrupter, consisting of a spring, U, whose free end bears upon a hub or disk, T, whose surface is composed of alternate conducting and non-conducting material, one or a series of alternations being used. While the spring U bears on a conducting portion of T the circuit through M is complete, and the poles P P′ attract a', pulling the shaft B to its limit of movement in one direction. When the circuit is broken a spring, *s*, forces the shaft to its limit in the opposite direction.

The hub or disk T may be attached to any rotating part of a machine, or it may be driven by an independent motor. If it be so geared that its rate of speed is different from that of B, the movements of B will not occur at the same relative times in consecutive rotations, and the wear of the commutator will be evenly distributed over its whole face, and it will be thereby evenly worn and polished.

One circuit-breaker, U T, may control the circuit for a number or battery of generators or motors; or a series of them may be arranged

upon one shaft, each controlling the circuit to a generator or to a motor, and arranged to operate in succession.

G is a centrifugal governor, connected to the shaft B by a belt, *g*. It is evident, however, that this governor may be placed on the shaft, or may be geared directly thereto. The sliding tube G′ of the governor, raised or lowered by the action of the governor-balls, carries a shoulder, *h*, taking under a pivoted lever, H, whose free end normally rests upon an adjustable stop, I. The circuit *x x* of a small battery, L B, passes through the lever H and stop I. This circuit *x x* also passes through an electro-magnet, L L, whose armature-lever N is pivoted in suitable standards, 1 2. The free end of this lever N is widened out into a plate, *n*, which takes under the free ends of a series of circuit-springs, (in this case four in number,) $O' O^2 O^3 O^4$, which number, however, may be greater or less, as desired. These springs are attached to an insulating-support, Q, and are arranged, when not lifted by N *n*, to rest upon contact-posts $R' R^2 R^3 R^4$. The motor-circuit M C passes to the spring O′ and post R′, then by wire to spring O^2 and post R^2, and so through the series.

The lever H and post I are adjusted so that they shall remain in contact whenever a desired predetermined speed is not exceeded, but that H shall be lifted from I when such speed is exceeded. In this latter event the circuit *x x* is broken between H and I, the magnet L is discharged, the armature-lever N is raised by the force of its spring, lifting the springs O′ O^2, &c., from their posts and breaking at each the motor-circuit M C. By this means a motor may be kept in action with a steady speed and the destructive effects of one large main-circuit spark lessened very materially by dividing into several minor sparks; or by increasing the number of springs and contact-posts for breaking the main circuit any sensible spark effect may be entirely obviated.

If desired, the battery L B, circuit *x x*, and magnet L L may be dispensed with and the springs $O' O^2 O^3 O^4$, &c., be operated directly by the lever H. Further, several magnets L and armatures might be used, one being assigned for each spring or for each division of two or more springs of the entire number used. In addition, upon the shaft B is mounted a heavy fly or balance wheel, F W, whose momentum serves to avoid too sudden fluctuations in speed upon breaking the circuit.

What I claim is—

1. The combination, with a commutator, of a contact brush or brushes and a brush holder or holders supporting the brush or brushes upon the face of the commutator at an angle to the axis of rotation thereof, substantially as set forth.

2. The combination of a commutator, contact brushes or springs arranged at an angle to the axis of the commutator, and brush-holders having both a vertical and horizontal adjustment, substantially as set forth.

3. In a dynamo or magneto electric machine, the combination, with the revolving commutator-cylinder and means for automatically giving such cylinder a continuous longitudinal reciprocating movement equal to the length of the commutator-cylinder, of stationary commutator-brushes bearing on such cylinder, whereby the commutator-cylinder will be worn evenly and smoothly, substantially as set forth.

4. In a dynamo or magneto electric machine, the combination of the revolving commutator-cylinder with a magnet and a circuit-controlling device giving said cylinder a longitudinal reciprocating movement, and stationary commutator-brushes, whereby the commutator-cylinder will be worn evenly and smoothly, substantially as set forth.

5. The combination, with the main circuit, of a circuit-breaker, constructed as described, adapted to break or close the main circuit at several points simultaneously, substantially as set forth.

This specification signed and witnessed this 11th day of March, 1880.

THOMAS A. EDISON.

Witnesses:
Z. F. WILBER,
JOHN C. SCHROEDER.

(No Model.)

T. A. EDISON.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

No. 264,650. Patented Sept. 19, 1882.

Fig. 1.

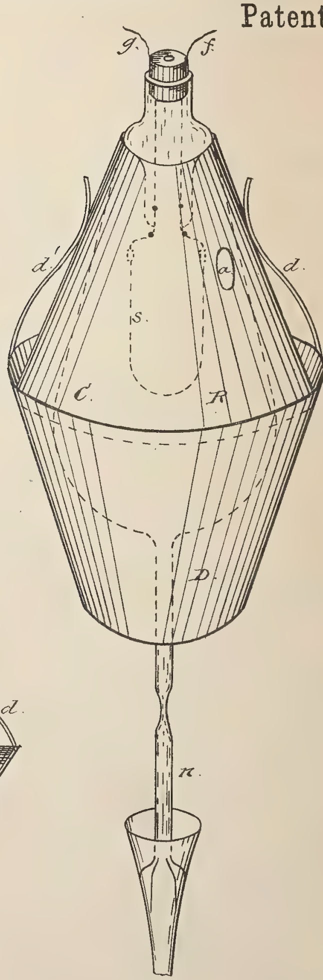


Fig. 2.

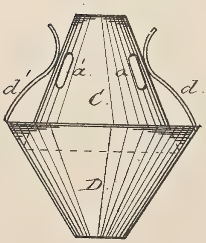


Fig. 4.

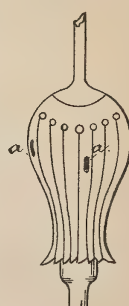
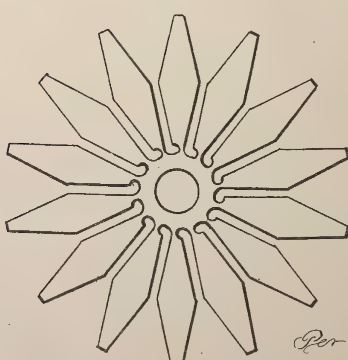


Fig. 3.



Attest;
F. W. Howard
M. J. Clagett

Inventor;
T. A. Edison
Per Dyer & Wilber
Att'ys

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 264,650, dated September 19, 1882.

Application filed December 9, 1881. Renewed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescing Electric Lamps (Case No. 382;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to facilitate the exhaustion of the vacuum-chambers of incandescent electric lamps.

The invention consists in inclosing the lamp while it is being exhausted in a metallic or other inclosing case or envelope capable of retaining heat, which envelope will be heated by the current passing through the carbon of the lamp, and so heat the air remaining in the globe as to assist in driving it out.

A form of my invention is shown in the drawings, in which Figure 1 is a view of a lamp surrounded by its metal case; Fig. 2, a detail view of a portion of the same, and Figs. 3 and 4 views showing the manner of forming another kind of metal case.

C is the inclosing-globe of an incandescent electric lamp in the process of exhaustion, *s* being its carbon filament and *n* the exhaust-tube leading to the Sprengel air-pump.

D R is a metal case placed around the lamp, consisting of two cones, the upper fitting within the lower, and the whole held against the lamp by spring-fingers *d d'*. This case may instead be made by punching out a piece of sheet metal, as in Fig. 3, and then bending it up around the lamp-globe, as in Fig. 4. Apertures *a* are provided through which to observe the carbon filament. The current is applied to the carbon *s* through the conductors *f g*, and the heat thus produced heats the inclosing-case D, so that all parts of the globe C are equally heated and the air is more rapidly driven out.

It is evident that, instead of using the metal case shown, the globe might be coated with a metallic foil or with an opaque powder—such as lamp-black—which can be removed after the lamp has been heated, exhausted, and sealed off.

What I claim is—

1. The combination, with the inclosing-globe of an incandescent electric lamp, of means situated without the globe for retaining the heat caused by the incandescence of the carbon filament, substantially as and for the purpose set forth.

2. The combination, with the inclosing-globe of an incandescent electric lamp, of an inclosing case or envelope adapted to be heated by the incandescence of the carbon filament and to retain the heat so generated, substantially as and for the purpose set forth.

3. The metal case or envelope composed of radial strips bent up around the globe, substantially as set forth.

This specification signed and witnessed this 5th day of December, 1881.

T. A. EDISON.

Witnesses:

H. W. SEELY,

WM. H. MEADOWCROFT.

(No Model.)

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 264,651. Patented Sept. 19, 1882.

Fig. 1.

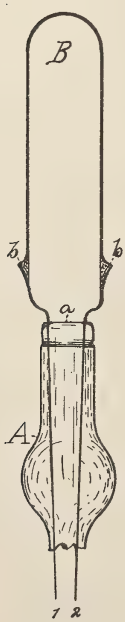
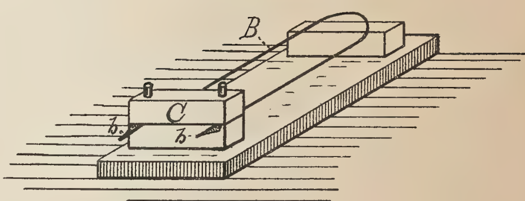


Fig. 2.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

T. A. Edison

per Richd N. Dyer,

Atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 264,651, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescent Electric Lamps, (Case No. 441;) and I do hereby decare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce a simple and efficient method of and means for securing the enlarged ends of the flexible carbon filament of an incandescing electric lamp to the leading-in wires of the lamp, and for making good contacts and lasting connections at the junctures of these parts. This I accomplish by first electroplating the enlarged ends of the flexible carbon filament, and then fusing or soldering the ends of the leading-in wires to such electroplated ends of the carbon. This may be done in the flame of a blow-pipe, the limbs of the flexible carbon filament above the electroplating being held and protected by a suitable covering-clamp to prevent the flame from touching and oxidizing the carbon, and to hold the ends in a fixed position.

In the drawings, Figure 1 represents the inside parts of an incandescing electric lamp, the flexible carbon filament being secured to the leading-in wires in accordance with this invention; and Fig. 2 represents the flexible carbon filament held by the protecting-clamp, as in the operation of fusing or soldering the leading-in wires thereto.

A is the glass tube through which the leading-in wires 1 2 pass, such wires being sealed in the closed upper end of the tube, as shown at *a*, and bent outwardly above such tube.

B is the flexible carbon filament, having enlarged ends *b*, which are electroplated with copper or other suitable metal. The limbs of the filament are held by a clamp, C, which grasps the upper end of the electroplating. The tube A is then manipulated so as to bring the ends of the wires 1 2 in contact with the plated ends of the carbon filament. The wires are then secured to such plated ends by fusing the ends of the wires or by soldering in the flame of a blow-pipe or with a hot soldering-iron.

It is evident that instead of securing the plated ends of the carbon filament directly to the leading-in wires short pieces of wire can be first fused or soldered to such plated ends and be then fused or soldered to the leading-in wires.

What I claim is—

The method of securing the ends of the flexible carbon filament of an incandescing electric lamp to the leading-in wires of the lamp, consisting in first electroplating the ends of the flexible carbon filament, placing such filament in a clamp protecting the filament above the plated ends, and then soldering or fusing the wires to such plated ends, substantially as set forth.

This specification signed and witnessed this 9th day of June, 1882.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,

EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 264,652. Patented Sept. 19, 1882.

Fig. 1.

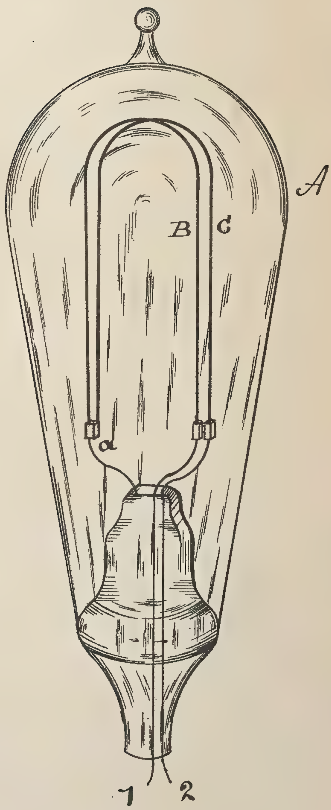


Fig. 2.

WITNESSES:

Thomas E. Birch.

S. D. Mott

INVENTOR:

T. A. Edison

BY Richd. N. Dyer.

ATTORNEY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 264,652, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Electric Lamps, (Case No. 387;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to so place two carbon filaments close together in the same incandescent electric-lamp globe that they will remain at the distance apart at which they may be placed without danger of their bending over and approaching each other near enough to allow an arc to form between them. The carbons used are my ordinary arched carbons. Two of these, which are carbonized separately, have each an end electrically connected to an end of the other by electroplating or in other suitable manner, and are placed side by side, parallel, and at the proper distance apart. A filling of an earthy oxide, or other suitable insulating material, is then placed between the filaments, so as to hold them apart. The carbons are then placed in the lamp, their separate ends being electroplated to the leading-in wires of the lamp, after which the lamp is exhausted. During the last stage of the process of exhaustion the carbons of the lamp are heated by an electric current to an incandescence higher than that at which they are intended to be used. This heat decomposes the material between the carbons, which is removed or partially removed from the globe with the air, after which it will be found that the carbons have become fixed rigidly in their position. The lamp is "sealed off," and is then ready for use.

In the drawings, Figure 1 is an elevation of a completed lamp, and Fig. 2 a view of a portion of the two carbons with the separating-filling between them.

A is the inclosing lamp-globe, and 1 2 the leading-in wires.

B C are carbons, united together at *a*, and thus arranged in series in the lamps.

b is the filling of plaster—such as plaster-of-paris—or other suitable material.

The carbons are supported by a wire.

It is evident that the two carbons could be used in multiple arc instead of in series, if one of the leading-in wires were attached at *a*.

What I claim is—

The method of preparing two or more contiguous carbon filaments for use in the same incandescing electric lamp, consisting in separating such carbon filaments by a filling capable of being decomposed or disintegrated by heat, and then fixing the relative position of such carbon filaments, and removing at the same time the separating-filling, by bringing such carbon filaments up to a point of high incandescence, substantially as set forth.

This specification signed and witnessed this 15th day of December, 1881.

THOMAS A. EDISON.

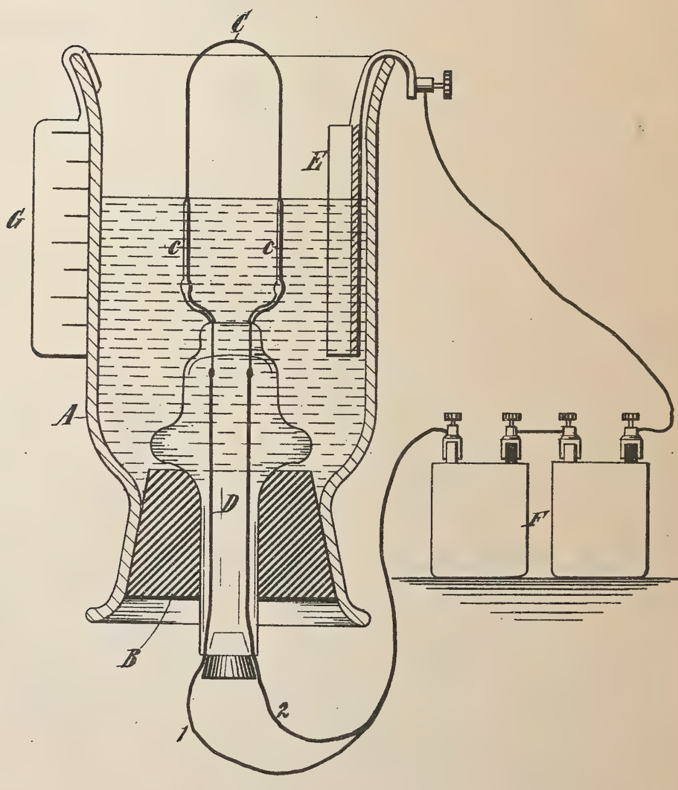
Witnesses:
H. W. SEELY,
RICHD. N. DYER.

(No Model.)

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 264,653. Patented Sept. 19, 1882.



WITNESSES:

O. D. Mott
Thomas E. Birch.

INVENTOR:

T. A. Edison

BY Richd. N. Dyer,
ATTORNEY

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 264,653, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescent Electric Lamps, (Case No. 385;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object I have in view is to produce, in a simple and efficient way, carbon filaments for my incandescing electric lamps of different candle-power and resistance, and to make such varying filaments from carbon filaments of the same or nearly the same size and resistance, which may be, for example, the filaments used in my standard sixteen or eight candle power lamps. This I accomplish by electroplating the carbon filaments for a portion of their length, preferably of copper, the non-plated portion alone becoming incandescent. Carbon filaments of a loop, arch, or horseshoe shape are plated preferably from their ends, where they are secured to the leading-in wires of the lamps, the center of the incandescing portion of the carbons being at the central point of their length and the candle-power and resistance of the carbons being dependent upon the extent of their non-plated portion.

In carrying out my invention I employ an electroplating or depositing cell provided with one or more perforated elastic stopples in its bottom, which receive the tubular glass support in which the leading-in wires of the lamp are sealed, as set forth in Patent No. 248,436. The cell is filled with a copper-plating solution until it rises upon the carbon filament or filaments to the desired height, which may be regulated and determined by a properly-graduated scale arranged for that purpose. The carbon filament or filaments are connected to form the cathode of the cell, and the copper is deposited upon them, as will be readily understood. The carbon filaments are preferably secured to the leading-in wires by the same operation.

The foregoing will be better understood from the drawing, which represents in vertical section the electroplating cell, with the remaining parts of the apparatus in elevation.

A is the containing-vessel of the cell.

B is its perforated elastic stopple, in which is placed the tubular glass wire support D.

1 2 are the leading-in wires of the lamp, sealed in the flattened and closed upper end of D.

C is the incandescing filament of carbon, *c* being its plated portion.

E is the anode of the cell.

F represents the battery.

G is the scale. This scale may be placed upon the exterior of the cell if A is of glass, or marked directly upon the cell itself; but if A is of opaque material, without any transparent portion, the scale may be marked upon the interior of A or on a separate piece set within A.

What I claim is—

1. The method of marking carbon filaments for incandescing electric lamps of different candle-power and resistance, consisting in electroplating such a portion of their length that the non-plated or incandescing portion will have the desired candle-power and resistance, substantially as set forth.

2. A carbon filament for incandescing electric lamps, secured at its ends to conducting-wires, and having electroplated portions commencing at such ends and extending toward its center for reducing the length of its incandescing portion, substantially as set forth.

This specification signed and witnessed this 13th day of December, 1881.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,
S. D. MOTT.

(No Model.)

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 264,654. Patented Sept. 19, 1882.

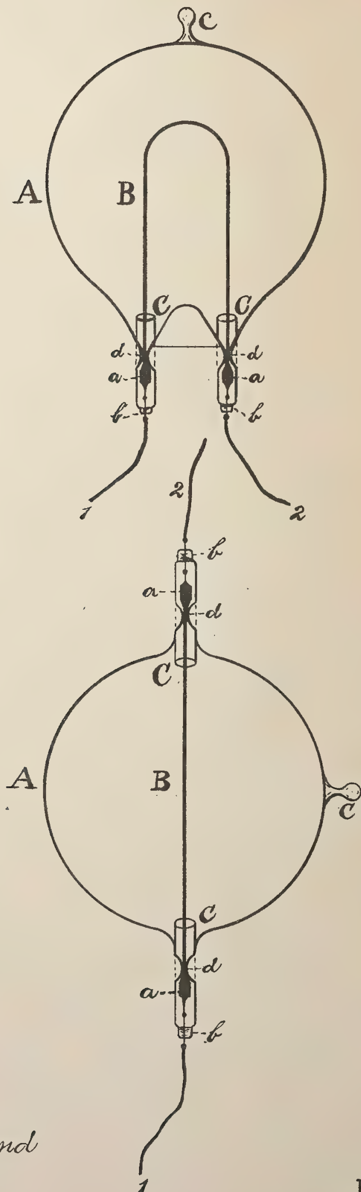


Fig 1.

Fig 2

WITNESSES:

Edward C. Rowland

H. W. Seely

INVENTOR:

T. A. Edison

BY Richd. N. Dyer.

ATTORNEY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 264,654, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescent Electric Lamps, (Case No. 396;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In the use of incandescent electric lamps in which the carbon incandescing conductor is attached to metal wires sealed in the glass of the inclosing-globe and extending up into the interior of such globe difficulty has sometimes been experienced from the exudation of the occluded air or other gases from the said metal wires and the clamps connecting them with the carbon, which may ensue upon the application of heat to the latter. Such occluded gases are removed from the carbon by heating it electrically during the process of exhausting the globe; but this heating is usually insufficient to completely eliminate them from the metal, and a portion of them therefore remain within the pores of the metal until driven forth by the heat occasioned by the passage of the electric current through the lamp. The vacuum thus becomes gradually impaired.

The object of my invention is to construct a lamp in which this difficulty shall not occur; and to this end my invention consists in a lamp having within its vacuum-chamber nothing but the carbon filament, the metal conductor and clamps being entirely outside. To accomplish this the ends of the carbon are first attached to the conducting-wires, (preferably by electroplating,) and a glass tube open at both ends is placed over each of the wires and pushed up so far as to include the point of union between the wire and end of the carbon within it. The lower end of the tube is then softened and pinched down upon the wires. The tubes holding the wires and carbons are then inserted into the glass inclosing-globe and hermetically sealed to the glass thereof by fusion. The air is then exhausted from the globe, the carbon filament being raised to high incandescence during the earlier part of this operation, and the globe is then sealed off at the exhausting-point, after which the glass of the tubes above mentioned is softened by heating at points above the junction of the carbon and wires and pinched down upon the carbon at such points. Thus the wires and all metallic portions of the lamp are excluded from the vacuum-chamber, which contains nothing but carbon. This may be better understood by reference to the annexed drawings, in which—

Figure 1 is a view of my lamp containing my ordinary U-shaped carbon, and Fig. 2 a view of a lamp in which a straight carbon filament is used.

A is the inclosing-globe, and B the carbon filament.

C C are the glass tubes, holding the ends of the wires 1 2 and of the carbon B, which are joined together at the points *a a* by electroplating. The wires 1 2 are sealed in the outer ends, *b b*, of the tubes, which are themselves fused to the glass of the globe A. The globe is exhausted at the point *c*, and the tubes are pressed down upon the carbon at points *d d*.

The wires 1 2 should be of platinum at the points where they pass through the glass.

What I claim is—

1. The exhausted inclosing-globe of an electric lamp, sealed directly upon the carbon incandescing conductor thereof, whereby all metal portions of the lamp are excluded from said globe, substantially as set forth.

2. The combination, with the exhausted glass globe of an electric lamp, of glass tubes projecting within and hermetically sealed to such globe, and having hermetically sealed within them the point of union of the incandescing conductor and the wires leading thereto, substantially as set forth.

3. The method of securing a stable vacuum in incandescing electric lamps, consisting in first exhausting the lamp and driving the occluded gases from the incandescing conductor by heating the same to high incandescence and then sealing the glass directly upon such incandescing conductor, substantially as described.

This specification signed and witnessed this 10th day of February, 1882.

THOMAS A. EDISON.

Witnesses:

H. W. SEELY,

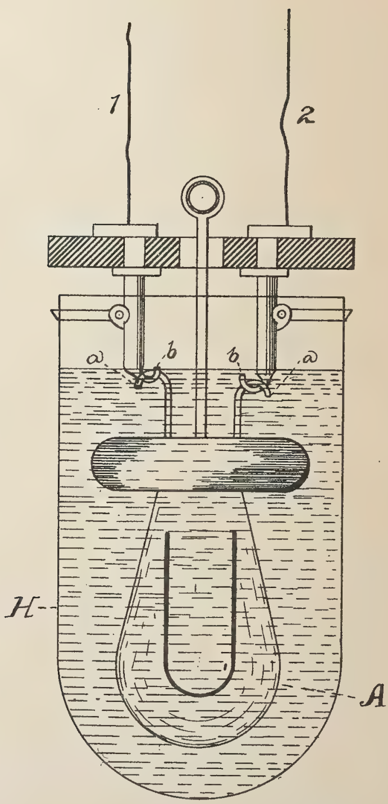
WM. H. MEADOWCROFT.

(No Model.)

T. A. EDISON.

INCANDESCING ELECTRIC LAMP.

No. 264,655. Patented Sept. 19, 1882.



WITNESSES:

E. C. Rowland,

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich^d. N. Dyer,

Atty.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCING ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 264,655, dated September 19, 1882.

Application filed August 7, 1882. (No model.) Patented in England September 27, 1881, No. 4,174; in Italy November 9, 1881; in France December 5, 1881, No. 145,554; in Canada December 14, 1881, No. 13,835, and in India January 18, 1882, No. 74.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Electric Lamps, (Case No. 444;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

In the use of incandescent electric lamps it is exceedingly convenient in some cases to have the leading-in wires of a lamp attached to the conductors in such a manner that they may be readily connected or disconnected at will, in order that a lamp may be used in one place or another, as desired. Such connecting and disconnecting of electrical conductors, however, produces a considerable spark, which in some locations—especially in mines, flouring-mills, powder-mills, or other places where explosions are likely to occur—would be very dangerous.

The object of this invention is to so arrange a lamp of this kind that all danger from the spark will be avoided. I accomplish this by submerging the points at which the connection is made in a transparent liquid not ignited by the spark. Glycerine is suitable for the purpose, it not being decomposed by the action of the current. The wires are preferably electrically insulated with a substance impervious to the liquid—such as rubber—so that only the points at which contact is made are exposed. The escape of electricity across from one conductor to the other at the exposed points will be quite inconsiderable.

A convenient form of my invention is shown in the accompanying drawing, which is a view thereof in elevation.

A is an incandescing electric lamp placed in a vessel, H, made entirely of glass or having one or more glass sides, and filled with glycerine or other suitable liquid. The leading-in wires *a a* of the lamp are formed into hooks, as shown, which engage with hooks *b b* connected with the conductors 1 2. Instead of two pairs of hooks, either pair could be rings or eyes and the other hooks. A weight, *c*, preferably a lead ring dropped over the neck of the lamp, is used to maintain good connection and to keep the lamp in a vertical position. The wires, except the hooks, should be coated with an insulating substance impervious to the liquid used.

It will be seen that the lamp can be readily connected and disconnected, and that any spark produced thereby, being in liquid, will not be liable to ignite any gases, flour-dust, or other inflammable substance which might exist in the neighborhood.

Instead of keeping the connections constantly submerged in liquid, they may be made and broken in a water-jar, but may be removed therefrom after being made, since no spark occurs, except on the making or breaking of the circuit.

What I claim is—

1. An incandescing electric lamp the leading-in wires of which are connected removably with the conducting-wires, the connections being submerged in liquid, substantially as set forth.

2. An incandescing electric lamp the leading-in wires of which are connected by hooks or hooks and eyes with the conducting-wires, such hooks or hooks and eyes being submerged in liquid, and the wires being insulated, except at the points of contact, with a coating impervious to the liquid, substantially as set forth.

This specification signed and witnessed this 9th day of June, 1882.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,

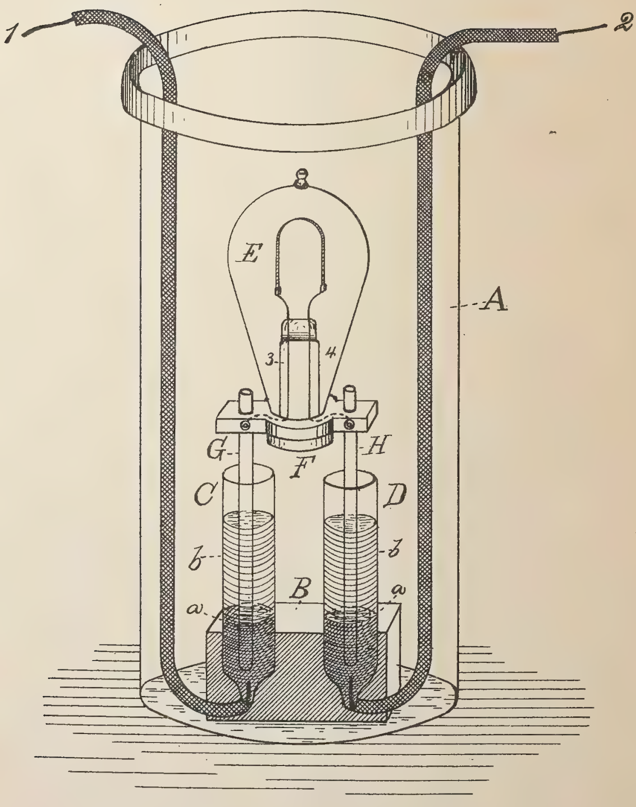
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 264,656. Patented Sept. 19, 1882.



WITNESSES:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer,
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 264,656, dated September 19, 1882.

Application filed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescent Electric Lamps, (Case No. 459;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of this invention is to produce means for making and breaking the connections of incandescing electric lamps, so as to prevent the ignition of inflammable gases, in order that such lamps may be used with safety in mines and similar places. This is accomplished by the use of two upright tubes containing water, into which rods from the lamp are plunged, preventing escape across between the connections, as is the case when a water-jar common to both connections is used. In the bottom of each tube mercury is placed, and the rods from the lamp dip into the mercury, so that there is no decomposition of the water. The lower ends of these tubes are sealed upon wires, preferably of platinum, from which extend insulated circuit-wires. The block supporting the tubes containing mercury and water and the lamp are preferably inclosed in a glass jar for protection. All the connections are made solid and permanent, except those between the rods from the lamp and the mercury, which latter connections being broken under water by raising the lamp there is no danger of igniting inflammable gases. The lamp may be arranged for breaking one connection only, mercury and water being used, as with the two separable connections.

The foregoing will be better understood from the drawing, which is a perspective view of the lamp and connections, the supporting-block being in vertical section.

A is a glass inclosing-jar, in the bottom of which is placed supporting-block B, of wood or other suitable insulating material. This block supports two upright glass tubes, C D, which have open upper ends, but are sealed at their lower ends upon wires, as shown, preferably of platinum. From these sealed wires extend the insulated circuit-wires 1 2. The tubes C D are partly filled with mercury, *a*, and above the mercury they are filled with water, *b*.

E is an incandescing electric lamp, supported upon a base, F, preferably of insulating material, from which base extend downwardly two metal rods, G H, connected with the leading-in wires 3 4 of the lamp. The rods G H are plunged into the water *b*, and are immersed at their ends in the mercury *a*, completing the circuit through the lamp. There is no escape across between the connections, as is the case, to a small extent, when the connections are made in the water of a jar common to both connections, and the water is not decomposed. To break the connections, the lamp is raised; but there is no danger of igniting inflammable gases, since the connections are made and broken under water. It is evident that the device could be constructed so that one connection only would be separable, the connection being made with mercury, above which would be a superimposed body of water.

What I claim is—

1. The combination, with the electrodes of an incandescing electric lamp, of two water-tubes having connections whereby the two connections with the lamps are separately made and broken under water, substantially as set forth.

2. The combination, with an electric lamp provided with a base from which extend metal rods connected with the leading-in wires of the lamp, of tubes containing mercury and water, and circuit-wires running from the mercury of the tubes, substantially as set forth.

This specification signed and witnessed this 7th day of July, 1882.

THOMAS A. EDISON.

Witnesses:

RICHD. N. DYER,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 264,657. Patented Sept. 19, 1882.

Fig 1

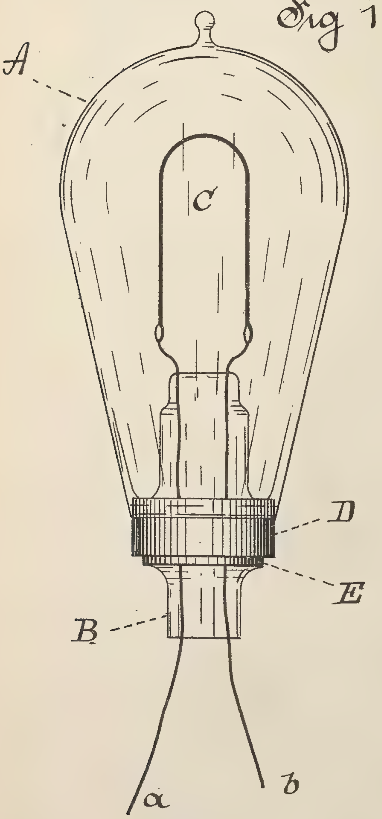
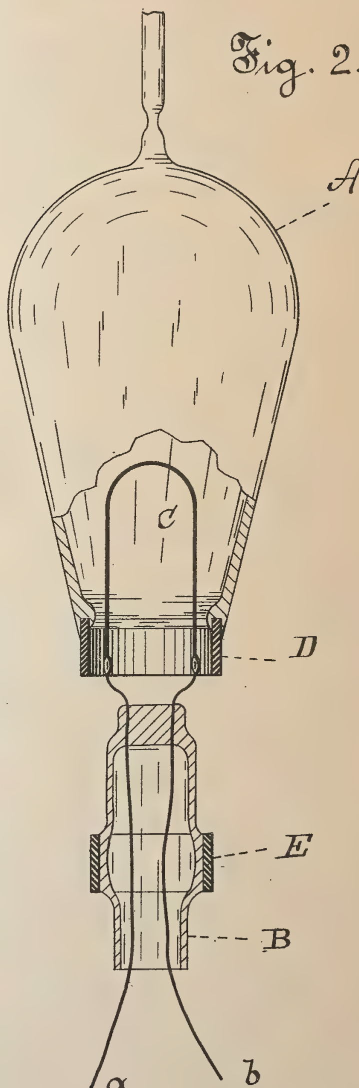


Fig. 2.



WITNESSES:

S. D. Mott

M. J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 264,657, dated September 19, 1882.

Application filed August 30, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescent Electric Lamps, (Case No. 322;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce another form of incandescing electric lamp, which can be taken apart when the carbon is destroyed and the principal parts again utilized. This I accomplish by providing the lower end or neck of the glass bulb or globe with a ring of platinum, which is sealed into the glass of the globe and is soldered to another platinum ring sealed into the glass of the wire-support. After the platinum rings are soldered together the globe is exhausted and sealed. When the carbon is broken the platinum rings can be separated by melting the solder by heat or eating it away with acid, and the parts can be used over again, it being only necessary to supply a new carbon filament, to solder the platinum rings together again, and to re-exhaust and reseal the globe. For this last purpose the globe will be heated at the top, and will be perforated and provided with a glass tube for making connection with a suitable exhausting apparatus.

In the drawings, Figure 1 is a view of the lamp complete, and Fig. 2 a vertical section of the two parts of the lamp before the platinum rings are soldered together.

A is the glass globe; B, the glass wire-support; C, the carbon filament, and *a b* the leading-in wires. D is a platinum ring, sealed to the glass at the lower end of the neck of the globe, and E is another platinum ring, which is dropped over the upper end of the glass wire-support, and sealed to the glass of the enlarged portion of the wire-support. One of these rings is preferably smaller than the other, so that they fit closely one over the other. These platinum rings are soldered together before the lamp is exhausted. To separate the two glass portions of the lamp the solder can be melted or eaten away by acid.

It will be understood that the tubular glass wire-support B is hermetically sealed at its upper end by being flattened and fused upon the leading-in wires *a b*, such leading-in wires passing out through this tube. After the globe A is hermetically sealed at its lower end, and secured to the support B by the soldering of the platinum rings D E together, the lamp is exhausted by means of the glass tube attached to the globe, which is sealed off by fusion of the glass. The joints between the platinum rings and the two glass portions of the lamp are made air-tight by the fusion of the glass upon such rings.

What I claim is—

1. In an incandescing electric lamp, the combination, with the two portions of the lamp made entirely of glass, of a joint between said parts, composed of two platinum portions attached to the glass parts by the fusion of the glass upon them, said platinum portions being hermetically secured together, substantially as specified.

2. In an incandescing electric lamp, the combination of the two portions of the lamp made entirely of glass, the carbon filament supported from one of said glass portions by leading-in wires passing through and sealed into the glass by the fusion of the glass thereon, and a separable metallic joint between the two glass portions of the lamp, substantially as specified.

3. In an incandescing electric lamp, the combination of the two glass portions with the lamp, of the carbon filament supported from one of said glass portions by leading-in wires passing through and sealed into the glass by the fusion of the glass thereon, a sealed glass exhausting-tube on one of said glass portions, and a separable metallic joint between the two portions of the lamp, substantially as specified.

4. In an incandescing electric lamp, the combination, with the glass globe A, of a tubular glass wire-support, B, extending up into the

globe and hermetically sealed at its upper end upon the leading-in wires, and the platinum rings D E, secured to the lower end of the globe and to the sides of said tubular support by the fusion of the glass upon said rings, such rings being secured together to form a separable air-tight joint, substantially as specified.

This specification signed and witnessed this 21st day of May, 1881.

THOMAS A. EDISON.

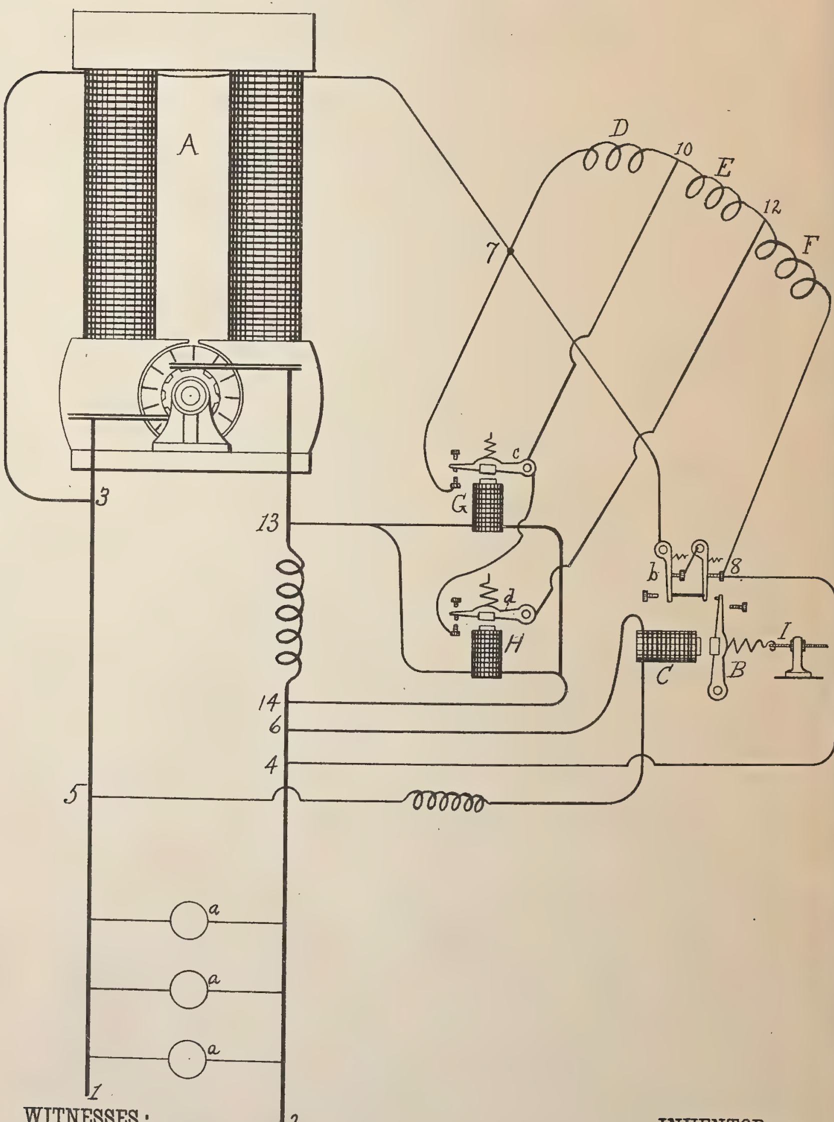
Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,658. Patented Sept. 19, 1882.



WITNESSES:

Edward C. Rowland

H. W. Seely.

INVENTOR:

T. A. Edison

BY Rich^d N. Dyer,

ATTORNEY.

N. PETERS, Photo Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,658, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Regulation of Dynamo or Magneto Electric Machines, (Case No. 407;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

In an application for a patent of even date herewith I have set forth a means of regulating the generation of current by dynamo or magneto electric machines by the use of a vibrating circuit-controller for regulating the energy of the field-magnet of the machine.

This invention relates to the same subject; and it consists in the use, in connection with this vibrating circuit-controller, of resistances for reducing the spark, so arranged in the field-circuit that when a certain definite proportion of the lamps or other translating devices supplied by the plant are in circuit a certain constant resistance for reducing the spark will be in the field. To do this I place in the field-circuit a vibrating circuit-controller, preferably one constructed so as to break circuit at several points simultaneously. This is preferably actuated by an electro-magnet placed in a multiple arc-circuit from the main line, and regulates the generation of current, as set forth in the application above referred to. In a shunt around the circuit-controller is placed a series of equal resistances, around which are formed shunts including the armatures of electro-magnets placed in a shunt or shunts from the main conductors. When only a few lamps are in circuit and little current passes in the main line the last-mentioned magnets are but slightly energized, and the shunt-circuits around the resistances in the field are open; but when the certain predetermined number of lamps is exceeded and a greater current flows in the main line one of the electro-magnets attracts its armature and closes the shunt around a portion of the spark-reducing resistance, for it is now unnecessary to have so large a resistance in the circuit; and this operation continues according to the number of parts into which the resistance is divided.

The invention may be better understood by reference to the drawing, which is a diagram illustrating the same.

A is a dynamo-electric machine, from which lead main conductors 1 2, the field-magnet being energized by a derived circuit, 3 4. In the circuit 3 4 is placed a vibrating circuit-controller, b, actuated by the movement of the armature-lever B of the electro-magnet C, the latter being in a derived circuit, 5 6. In a shunt-circuit, 7 8, around the circuit-controller b are constant resistances D E F. Around resistance D is a shunt, 7 10, including the armature-lever c of the magnet G, while a shunt, 10 12, around E includes armature-lever d of magnet H. The magnets G H are in multiple arc to each other in the shunt-circuit 13 14.

The operation of these devices is as follows: Each of the resistances D E F is proportioned for one-third of the lamps a a supplied by the machine. As shown, only a few lamps are in circuit, and the resistances D E F are all in use for reducing the spark caused by the vibrations of the circuit-controller b, which regulates the machine, a suitable device, I, being used to adjust the tension of the spring B, and so regulate the candle-power of the lamps; but when more than one-third of the entire number of lamps is placed in circuit the increase of current in the shunt 13 14 causes the magnet G to attract its armature, which closes the shunt-circuit 7 10 and cuts out the resistance D, for as more current must now flow in the field, it is desirable to decrease the resistance in the shunt so as to reduce the spark at the breaking-points. The magnet H and armature d are so arranged that a greater amount of current is required to attract the armature than is the case with magnet G. When more than two-thirds of all the lamps are placed in circuit the armature d is attracted and the resistance E cut out of circuit, leaving in only the resistance F for reducing the spark. The resistances, by reducing the spark at the breaking-points, and thus preventing sudden fluctuations of current, prevent any sudden varyings of candle-power or flickerings in the lamps which might otherwise ensue. The throwing in and out of these resistances has, however, no direct effect upon the lamps, but simply and solely affects the spark caused by the breaking of circuit.

Instead of using the magnet C to operate

the circuit-controller directly, it, being wound to respond quickly to variations of current, could be used to open and close the circuit of another magnet which would do the work, this magnet being placed in any convenient location, but preferably in a shunt around the resistance in the main line or around the resistance F in the field.

It is evident that this invention is as well adapted to magneto as to dynamo electric machines, or to machines in which the main current energizes the field-magnet, in which case the circuit-controller *b* would be in a shunt around the field.

It is also evident that the number of spark-reducing resistances and of electro-magnets connected therewith and the proportion of lamps required to be in circuit in order that these magnets will operate might be varied in any desired manner.

I do not claim broadly the use of a vibrating circuit-controller for regulating the generation of current, or a spark-arresting shunt around such a circuit-controller, or providing such a circuit-controller with an adjustable retractor, since such invention forms the subject-matter of claims in my application No. 68,627, of even date herewith.

What I claim is—

1. The combination, with a dynamo or magneto electric machine, of a vibrating circuit-controller for regulating the generation of current, and a shunt around said circuit-controller containing a series of constant resistances for reducing the spark, and means adapted to cut each of such resistances into or out of circuit by the removal or addition of a definite predetermined number of translating devices, substantially as set forth.

2. The combination, with the vibrating circuit-controller and spark-reducing resistances in a shunt around the circuit-controller, of the electro-magnets in a shunt from the main line, each adapted, upon the addition or removal of a certain number of translating devices, to cause the throwing in or out of circuit of a portion of the spark-reducing resistances placed in a shunt around the vibrating circuit-controller, substantially as set forth.

3. The combination of the vibrating circuit-controller placed in the field-circuit, the electro-magnet for operating the same, placed in a derived circuit from the main line, the series of constant spark-reducing resistances placed in a shunt around the circuit-controller, and the series of electro-magnets in a shunt from the main line, for throwing said resistances out of circuit one after another, as desired, substantially as set forth.

This specification signed and witnessed this 28th day of February, 1882.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

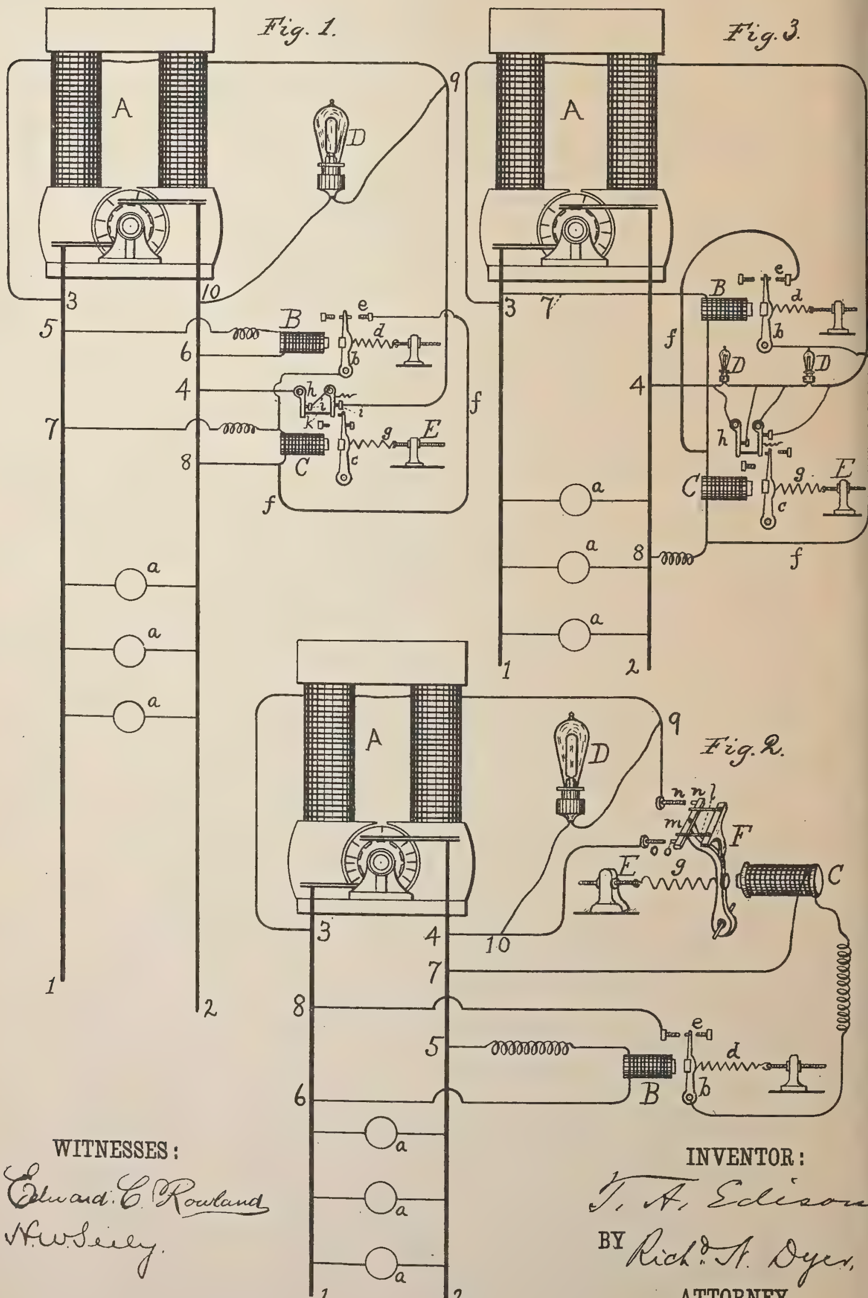
THOMAS JOHNSTON.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,659. Patented Sept. 19, 1882.



WITNESSES:

Edward C. Rowland

H. W. Seely

INVENTOR:

T. A. Edison

BY Richd. N. Dyer,

ATTORNEY

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,659, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Regulation of Dynamo or Magneto Electric Machines, (Case No. 406;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to produce means for automatically regulating the generation of current by a dynamo or magneto electric machine supplying current to a mutiple-arc system of electrical distribution, which shall not vary the resistance of or the current flowing in the field-circuit of the machine, and shall be exceedingly and unusually sensitive in their action, responding instantly to the slightest variation in the current on the main line. This I accomplish in the following manner: Two electro-magnets are placed each in a derived circuit from the main conductors of the generator, and each actuating a vibrating circuit-controller. The circuit-controller of one magnet opens and closes a circuit whose opening and closing controls or assists in controlling the energy of the other magnet, whose vibrating circuit-controller is placed in the field-circuit, so as to regulate the energy of the field-magnet of the machine, as explained in another application made by me of even date herewith; or where the main circuit includes the field-coils the circuit-controller would be placed in a shunt-circuit around such coils. One or more shunt-circuits may be formed around the last-mentioned circuit-controller, (which is preferably one which makes and breaks circuit at several points simultaneously,) such shunts having a high resistance, and being used to decrease the spark which might otherwise ensue.

In the drawings, Figures 1, 2, and 3 are diagrams of different forms of my invention.

Referring to Fig. 1, A is a dynamo-electric machine, from which lead main conductors 1 2, having lamps or other translating devices, *a a*, placed in multiple arc upon them.

3 4 is a multiple-arc circuit including the field-magnet of the machine.

In multiple-arc circuits 5 6 and 7 8 are placed respectively the electro-magnets B and C. The magnet B is provided with a pivoted armature-lever, *b*, retracted by a spring, *d*, its free end making and breaking contact at *e*, and thus opening and closing the shunt-circuit *f* around the magnet C, of which circuit the armature-lever *b* forms a part. The magnet C has pivoted armature *c*, retracted by spring *g*. The movement of this armature causes the vibration of the circuit-controller *h*, which, in order to reduce the spark, is made to break circuit simultaneously at points *i i*, *k* being an insulating-pin. This circuit-controller regulates the machine as in the application above referred to. A shunt-circuit, 9 10, is formed around this circuit-controller, containing a high resistance, preferably an incandescent electric lamp, D, in order that the spark may be still further reduced; or the shunt-circuit may include a portion of the field-magnet coils with the same result. The opening and closing of the shunt *f*, controlling the energy of the magnet C, increases the sensitiveness of the action of the circuit-controller *h*. All the movements of the armatures *c* and *b* are simultaneous, and thus a double effect, both in increase and decrease of energy, is produced in C.

In Fig. 2 the magnet B is used to close and open directly the circuit 7 8 through the magnet C, instead of a shunt around it. The circuit-controller F here shown is one in which the flat springs *l l* bear on the cross-piece *m*, and so keep the contacts *n n* and *o o* always in line. With the exception of the points above noted, this form is similar to that of Fig. 1.

In the form shown in Fig. 3 two incandescing electric lamps, D D, are used as resistances for decreasing the spark, and placed directly in the field-circuit 3 4, a shunt being formed around each, and both shunts being opened or closed simultaneously by the movement of the vibrating circuit-controller *h*. The magnet B is used to open and close a shunt, *f*, around the magnet C, as in Fig. 1, and the movement of the armature-lever *c* throws the lamps or other suitable high resistances, D D, in or out of circuit. In this case the magnets B C are placed in series in the same multiple-arc circuit, 5 6.

It is evident that in all these forms the field-circuit 3 4 might be a circuit supplied from an external source, or a shunt instead of a derived circuit from the main line; or the vibrating circuit-controller could be placed in a shunt around the field in those machines in which the main current energizes the field-magnet.

I do not claim broadly the use of a vibrating circuit-controller for regulating the generation of current, or a spark-arresting shunt around such a circuit-controller, or providing such a circuit-controller with an adjustable retractor, since such invention forms the subject-matter of claims in my application No. 68,627, of even date herewith.

What I claim is—

1. The combination, with a dynamo or magneto electric machine, of a circuit-controller operated by the current generated for regulating the generation of current by the machine, and a second circuit-controller, also operated by the current generated for controlling or assisting in controlling the current operating the first circuit-controller, as desired, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine, of a vibrating circuit-controller adapted to make and break circuit at several points simultaneously, and another vibrating circuit-controller for controlling or assisting in controlling the current operating the first circuit-controller, substantially as set forth.

3. The combination, with a dynamo or magneto electric machine, of two electro-magnets placed in a multiple-arc circuit or circuits from the machine, and each provided with a vibrating circuit-controller, one for regulating the generation of current by the machine, the other for controlling or assisting to control the supply of current energizing the first, substantially as set forth.

4. The combination, with the two vibrating circuit-controllers, one for regulating the generation of current, the other for controlling the supply of current to the first, of the spark-arresting shunt around the first circuit-controller, substantially as set forth.

5. The combination, with an electro-magnet placed in a multiple-arc circuit from a dynamo or magneto electric machine, and a vibrating circuit-controller operated thereby and placed in the field-circuit of the machine, of an electro-magnet placed in the same or another multiple-arc circuit, and a vibrating circuit-controller for controlling the current energizing the first-mentioned electro-magnet, placed in the circuit of said first-mentioned magnet or in a shunt around the same, substantially as set forth.

This specification signed and witnessed this 28th day of February, 1882.

THOS. A. EDISON.

Witnesses:

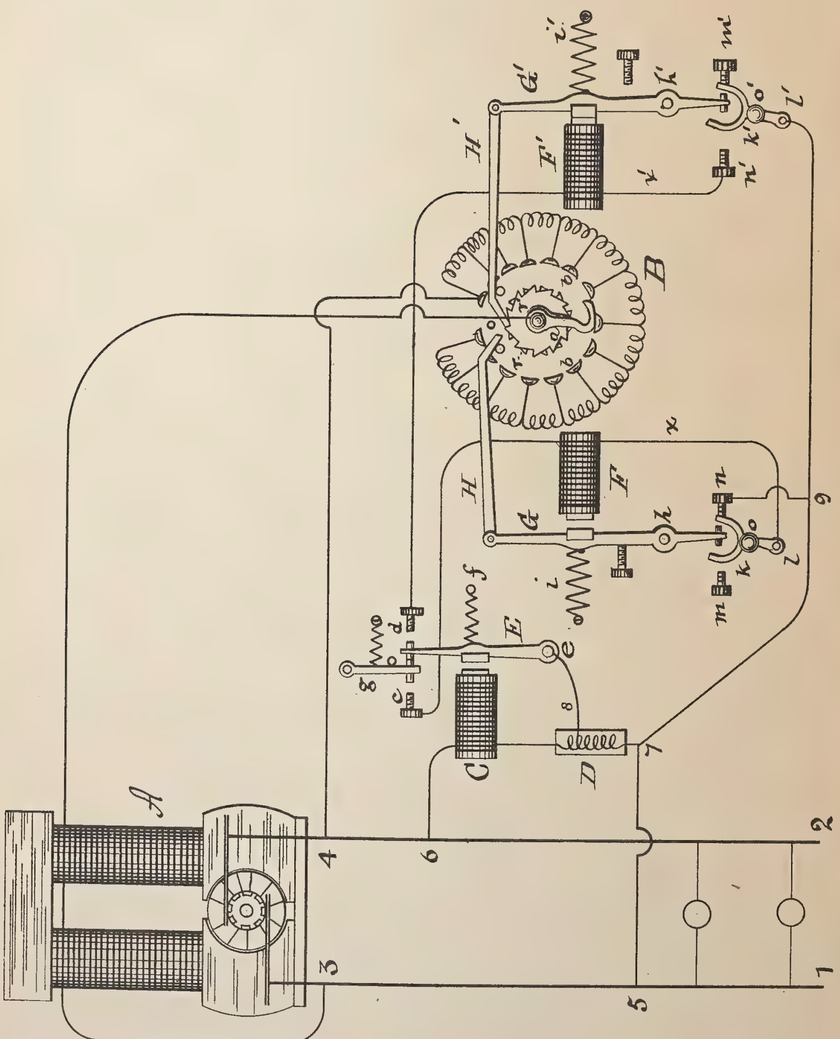
H. W. SEELY,
THOMAS JOHNSTON.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,660. Patented Sept. 19, 1882.



WITNESSES:

D. D. Mott
Thomas E. Birch.

INVENTOR:

T. A. Edison

BY Richd. N. Dyer,

ATTORNEY.

N. PETERS. Photo-Lithographer. Washington. D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,660, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Regulating the Generative Capacity of Dynamo or Magneto Electric Machines, (Case No. 375;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to means for automatically varying the resistance of the field-circuit of a dynamo or magneto electric machine for the purpose of regulating the generation of current by the machine, the object I have in view being to produce a continuously-acting mechanism for this purpose, and one in which the increase or decrease of resistance is not limited by the movement (necessarily small) of the armatures of electro-magnets, and which mechanism, further, will be efficient in operation, will maintain the lamps at a practically-constant candle-power, and prevent the light from flickering.

Generally speaking, my arrangement is as follows: In the field-circuit of a dynamo-machine is placed a circular adjustable resistance, having its contact-points arranged inside, portions of the resistance being cut in and out by a contact-arm forming part of the circuit and pivoted in the center of the resistance. The contact-arm is turned by ratchet-wheels, one adapted to be moved by a pawl in one direction, the other by another pawl in the opposite direction, so that resistance is placed in or thrown out of circuit as one or the other pawl is in operation. Each of these pawls is moved by the vibrating armature of an electro-magnet. To effect the make and break of circuit which causes the vibration of the armature, one end of the latter extends between the sides of a pivoted U-shaped piece, which is driven by the movement of the armature in one direction to complete the circuit and in the other direction to break it, the U-piece being weighted, so that its motion is assisted by gravity; or a spring may be used for this purpose. Each of the electro-magnets operating these vibrating armatures is placed in a circuit which is a division of a shunt-circuit from a multiple-arc circuit, the last containing an electro-magnet and a resistance for turning current into the shunt. The pivoted spring-armature of this magnet forms a part of the shunt-circuit, and its free end is placed between contact-points. A pivoted spring-arm is also placed between these contact-points in such manner that the forward movement of the armature forces it against one of them and completes one of the divisions of the shunt-circuit, while the armature, when drawn back a sufficient distance, strikes the other contact-point and completes the other division. Normally, however, the armature and spring-arm are held by the resilience of their springs and by a properly-placed stop midway between the contact-points, and either circuit is completed only by an increase or decrease in the force of the electro-magnet. When too much current is in the main circuit it is desirable to decrease the generative capacity of the machine by placing more resistance in the field-circuit. The magnet in the multiple-arc circuit of course has its energy increased by the excessive quantity of current in the main line, and attracts its armature, which pushes the spring-arm against a contact-point, thus closing a division of the shunt, including one of the first-mentioned electro-magnets, whose vibrating armature is set in motion, moving the pawl and turning the ratchet-wheel and contact-arm in such a direction that more resistance is placed in the field circuit. The current in the main circuit then decreases, and the magnet in the multiple-arc circuit weakens in power until the armature is drawn away by the spring and the circuit of the electro-magnet which actuates the contact-arm is broken; but if the current is very much decreased, so that it becomes necessary to throw out resistance, the first armature-lever is drawn back by its spring and closes the other division of the shunt-circuit through the other electro-magnet, whose pawl-arm turns the contact-arm in the opposite direction and throws out a portion of the resistance.

The controlling electro-magnet of the mechanism, as before explained, is placed in a multiple-arc circuit. In this location it is effected, exactly as is a lamp, by variations caused by changes in the number of translating devices and in the speed of the engine. To prevent

the light from flickering it is necessary to provide means for determining the central position of the armature-lever of the controlling electro-magnet. This is done by the spring-arm, against which the armature-lever strikes, the armature-lever bearing normally against this arm with such pressure that it is not affected by small magnetic changes. The two magnets, vibrating armature-levers, and circuit-controllers for working the contact-arm of the resistance form two electro-motors, which act appositely upon the resistance, and are brought into action separately by the controlling-magnet.

The accompanying drawing is a diagram showing an appropriate manner of carrying out my invention.

A is a dynamo-electric machine, from which lead the main conductors 1 2 of a multiple-arc system.

3 4 is a multiple-arc circuit, including the field-magnets of the dynamo. The wire 4 includes the circular adjustable resistance B, while the wire 3 terminates in a pivoted contact-arm, *a*, adapted to make contact with the points *b b* of the resistance B.

5 6 is another multiple-arc circuit, including an electro-magnet, C, and a resistance, D. Around the latter is formed a shunt-circuit, 7 8, which is divided into two circuits, 9 *x c* and 9 *x′ d*, *c* and *d* being contact-points. Either or both of the wires 7 8 may, if desired, be made adjustable, so that they may be connected with different parts of the resistance D, and thus shunt more or less current into the circuit 7 8.

The magnet C is provided with an armature, E, pivoted at *e* and forming part of the circuit 7 8. At its free end it is provided with two contact-points, one on each side. The armature has also a spring, *f*, whose tendency is to withdraw it from the magnet C. A pivoted spring-arm, *g*, is so placed that normally it is midway between *c* and *d*, but may be pressed over by the armature, so as to contact with *c* and close the circuit 9 *x c*. When the pressure is removed the circuit is broken until the magnet becomes so weak that the armature is drawn back againt *d* and closes the circuit 9 *x′ d*. The spring-arm *g* determines the central position of the armature-lever E, as before explained, and prevents the lever E from being vibrated by small magnetic changes in C.

The circuit 9 *c* includes a magnet, F, having an armature, G, pivoted at *h*, and having a spring, *i*. The lower end of the armature enters between the sides of the U-shaped metal piece *k*, which is pivoted at *l* and placed between stops *m n*. The wire *x* is attached at *l* and the wire 9 to the stop *n*, so that when *k* is thrown against *n* the circuit 9 *x c* is closed at this point and when it is thrown against *m* the circuit 9 *x c* is opened. A ball or weight, *o*, assists the motion of the piece *k*. Thus the movement of the armature G causes the make and break of the circuit, and the armature is made to vibrate. At the other end of the armature G is pivoted a pawl, H, which, when the armature G vibrates, moves the ratchet-wheel *r* and turns the contact-arm *a*, so that it places more of the resistance B in the circuit 3 4. A similar arrangement is placed on the opposite side of the resistance, F′ being the magnet, G′ its armature, *k′* the U-shaped circuit-reverser, and H′ the pawl actuating the ratchet-wheel *r′*, so that the contact-arm *a* is turned in the opposite direction and cuts out instead of putting in resistance.

It is evident that this invention is applicable to magneto-electric machines as well as to dynamos, and to a battery as well as to a single machine.

What I claim is—

1. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of an adjustable resistance in the field-circuit of such machine, an electrically-operated mechanism for adjusting said resistance, and an electro-magnet located in a multiple-arc circuit and controlling such electrically-operated mechanism, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of a mechanism for regulating such machine, an electro-magnet located in a multiple-arc circuit, and closing-circuits at the contacts of its armature-lever for controlling such regulating mechanism, and means for determining the central position of the armature-lever of said controlling electro-magnet, substantially as set forth.

3. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of an adjustable resistance in the field-circuit of such machine, a mechanism for adjusting such resistance, an electro-magnet located in a multiple-arc circuit and controlling such adjusting mechanism by closing-circuits at the contact of its armature-lever, and means for determining the central position of the armature-lever of said controlling electro-magnet, substantially as set forth.

4. The combination, with an electro-magnet energized by the current generated by a dynamo or magneto electric machine or battery thereof, of an armature-lever adapted to close by its forward and backward movement the branches of a divided shunt, which contain mechanism for varying the resistance of the field-circuit of the generator, substantially as set forth.

5. The combination, with a multiple-arc circuit, of a divided shunt therefrom, each division containing an electro-magnet provided with a vibrating armature, said vibrating armature being adapted to operate a pawl and a ratchet-wheel, substantially as set forth.

This specification signed and witnessed this 5th day of December, 1881.

T. A. EDISON.

Witnesses:

H. W. SEELY,
WM. H. MEADOWCROFT.

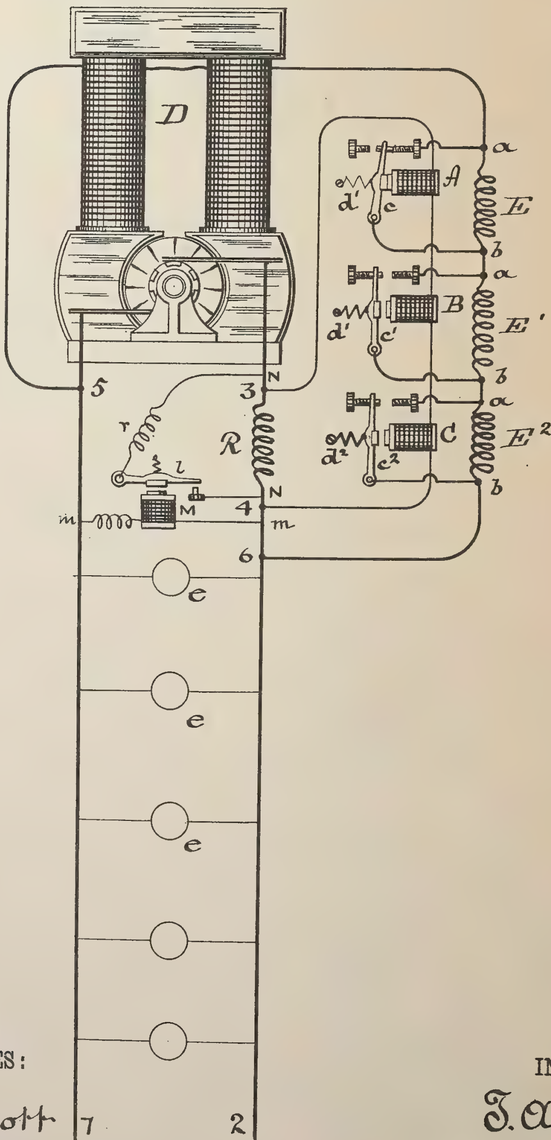
(No Model.) 3 Sheets—Sheet 1.

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,661. Patented Sept. 19, 1882.

Fig. 1



WITNESSES:

D. D. Mott

Thomas E. Birch.

INVENTOR:

T. A. Edison

BY Richd. N. Dyer,

ATTORNEY.

(No Model.)

3 Sheets—Sheet 2.

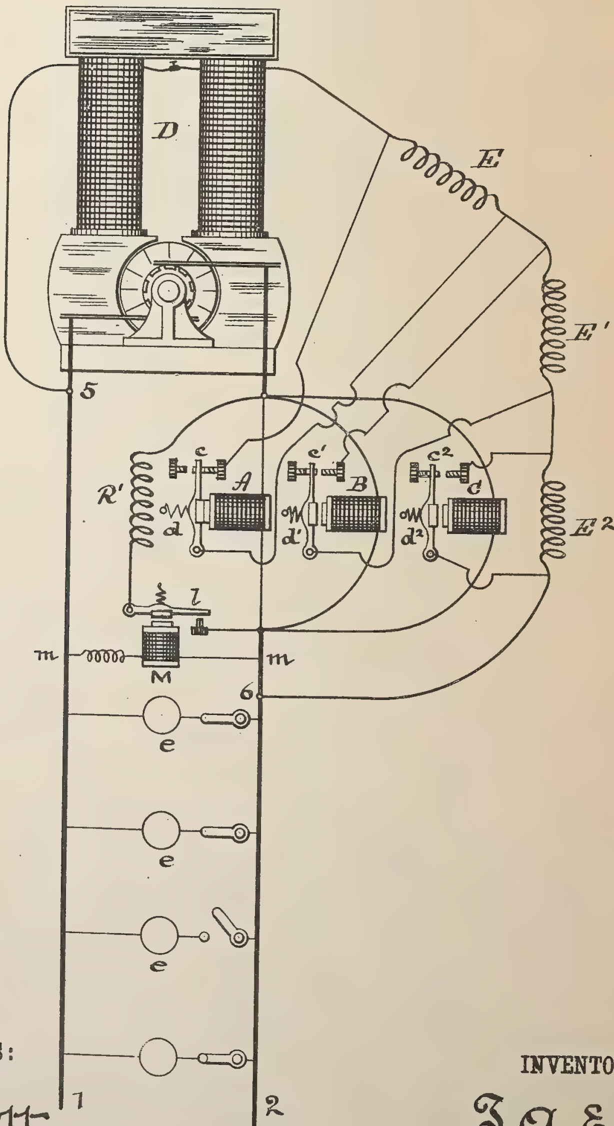
T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,661.

Patented Sept. 19, 1882.

Fig. 2.



WITNESSES:

S. D. Mott
Thomas E. Birch.

INVENTOR:

T. A. Edison

BY Richd. N. Dyer,

ATTORNEY

(No Model.) 3 Sheets—Sheet 3.

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Fig. 3.

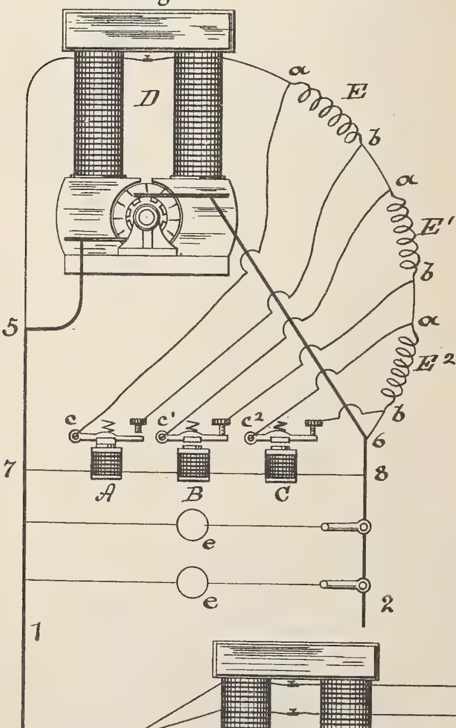


Fig. 5.

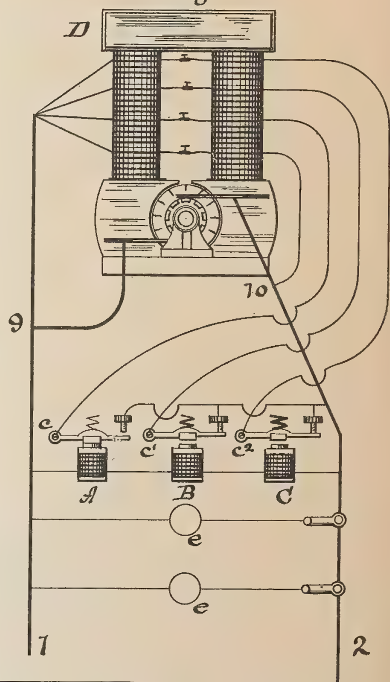
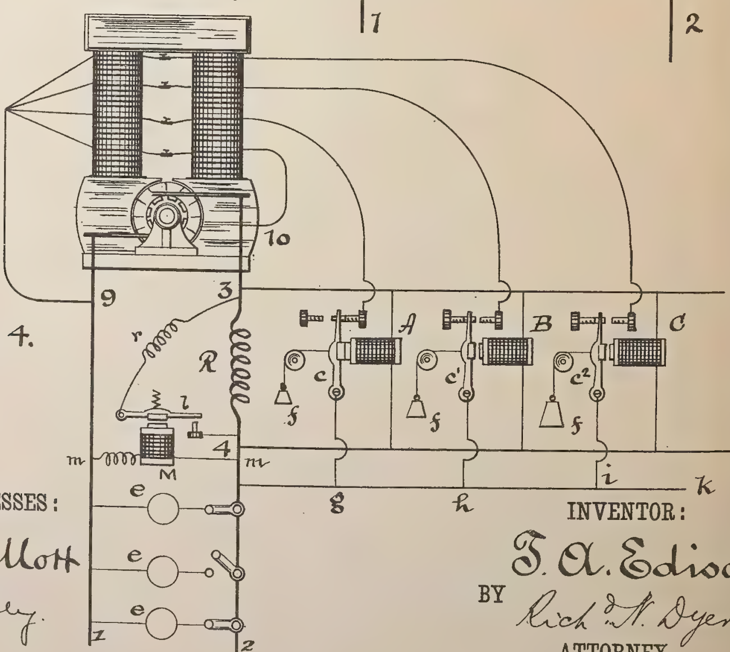


Fig. 4.



WITNESSES:

O. D. Mott

H. W. Seely

INVENTOR:

T. A. Edison

BY Richd N. Dyer.

ATTORNEY.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,661, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulating the Generative Capacity of Dynamo or Magneto Electric Machines, (Case No. 399;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to produce new and efficient means for varying the current energizing the field-magnet of a dynamo or magneto electric machine supplying a multiple-arc system of electric distribution for the purpose of regulating the generation of current by such machine. This I accomplish, first, by the use of several electro-magnets, each provided with an armature-lever, the relation between each armature-lever and its magnet being different from that of the others—that is, different currents being required to energize each magnet sufficiently to cause it to move its armature—this being accomplished by employing, in connection with the armature, different springs or weights by different windings of the various magnets, by varying the normal distances between the magnets and their armatures, or in any other suitable manner. The energy of these magnets is varied by variations in the current flowing in the main circuit from the dynamo or magneto electric machine, caused by the addition or removal of lamps or other translating devices in the system. The movements of the armatures above mentioned cause the opening and closing of circuits, the closure of each of which causes a greater amount of current to flow through the field-magnet of the generator. The electro-magnets may be placed directly in the main circuit of the generator, or in multiple-arc or derived circuits, or in a shunt-circuit therefrom, the circuits and contact-points connected with their armatures being arranged differently, according to the different conditions arising from the different positions in which the magnets are placed. When the magnets are placed in multiple-arc circuits from the mains their action compensates also for differences in the speed of the engine actuating the generator, which cause variations in the current produced; but when such magnets are in a shunt or in the main line this is not the case, and I therefore provide other means for this purpose. A magnet or magnets are placed in one or more multiple-arc circuits from the mains. Each magnet is provided with an armature-lever retracted by a spring and provided with contact-points, so that when attracted by its magnet the armature will close a circuit whose closure causes a decrease in the amount of current flowing through the magnets which control the field of force of the generator. Such circuit brings a shunt around the resistance, which turns current into the shunt containing the last-mentioned magnets, or a new branch of the main line passing around said magnets. Thus, if a sudden increase of speed in the engine causes an unusual flow of current, the magnet in the multiple-arc circuit causes less current to flow through those in the shunt, whose energy, being diminished, will cause a decrease in the current energizing the field-magnet of the generator, as before set forth.

The invention may be better understood by reference to the accompanying drawings, Figures 1, 2, 3, 4, and 5 being diagrammatic views of different forms thereof.

In Fig. 1 electro-magnets A B C are placed in a shunt, 3 4, around the resistance R from the main conductor 2, which leads from the dynamo-electric machine D.

5 6 is the field-circuit of such machine, and contains a series of resistances, E E′ E². The field-circuit is here shown as a multiple-arc circuit from the main line; but it is evident that it may be a circuit supplied from an external source, such as another dynamo or magneto electric machine or a battery.

A shunt-circuit, *a b*, is formed around each of the resistances E E′ E², a portion of each shunt being formed by one of the armature-levers *c c′ c²* of the magnets E E′ E². These pivoted armatures are provided with springs *d d′ d²*, which differ in tension.

When only a few lamps or other translating devices, *e e*, are placed in multiple-arc circuits on the main line, all the resistances E E′ E² may be in the field-circuit 5 6. As more lamps are turned on a greater electro-motive force is produced in the shunt-circuit in consequence

of the decrease in resistance of the main line. Therefore the armature c, which has the weakest spring, is attracted by the magnet A and closes the shunt $a\ b'$ around the resistance E, thus cutting the latter out of circuit and allowing more current to pass through the field-magnet of the generator, so that enough current is supplied for the additional translating devices. A still further addition to the number of the last causes the successive drawing forward of the armature c' c^2 and the throwing out of the resistances E' E^2. It is evident that any desired number of electro-magnets, armatures, and resistances may be used.

M is another electro-magnet, placed in a multiple-arc circuit, $m\ m$, and provided with a pivoted armature, l, which forms part of a shunt-circuit, N N, around the resistance R. A sudden increase of current, caused by an increase in the speed of the engine or by any unusual cause, increases the energy of the magnet M, which draws forward its armature l and completes the circuit 3 n, which, by opening a new path for the current, causes a less portion of it to pass through the magnets A B C, so that their energy is decreased, and the resistances E E' E^2 are successively placed in the field-circuit as desired.

A resistance, r, may be placed in the circuit N N, so that it shall not take too large a portion of the current. It is evident that any desired number of magnets M and circuits N N of different resistances may be provided, in order that successive paths may be opened for the current, and that in the circuit 3 4 be gradually diminished. In the form shown in Fig. 2 the magnets A B C are all placed directly in the main line in multiple-arc relation to each other.

Another similar branch of the main conductor contains a resistance, R', and the armature-lever l of the electro-magnet M, the latter being in a multiple-arc circuit, $m\ m$, from the main line. The successive drawing forward of the armatures c c' c^2 cuts out the resistances E E' E^2 from the field-circuit 5 6 of the generator D. An increase of current in the multiple-arc circuit $m\ m$, caused not by the condition of the translating devices, but by an increase in the speed of the motor driving the armature of the generator, causes an increase in the attractive force of the magnet M, which, by drawing forward its pivoted armature l, completes the circuit containing the resistance R, and thus by a further division of the current that flowing through the magnets A B C is lessened, and the resistances E E' E^2 are placed in circuit. It is evident in this case as well as in the preceding that the number of magnets M and of different paths for the current may be increased as desired.

In Fig. 3 the magnets A B C are placed in a multiple-arc, circuit, 7 8. Being in a multiple-arc circuit, such magnets are weakened by the addition of translating devices e e, and therefore the shunt-circuits $a\ b$ around resistances E are closed by the making of the back contacts instead of their forward ones. With this exception the operation is similar to those previously described. Instead of closing shunt-circuits around resistances in the field-circuit, the magnets A B C may be used to close additional circuits around the field-magnet, which is wound in bobbins or sections of wire, each of which forms part of a circuit, including one of the pivoted armature-levers c c' c^2.

In Fig. 4 the magnets are placed in the shunt-circuit 3 4 around resistance R. While here shown, for convenience, as in multiple arc across the wires of the shunt, it is evident that they may be placed as in Fig. 1. The present arrangement of the magnets is similar to that in Fig. 2. Instead of springs of different tensions, the armatures c c' c^2 are here provided with different weights f. A field-circuit of a constant high resistance, 9 10, is used to primarily energize the field-magnet of the generator D. This circuit may, if desired, be supplied from any external source instead of from the machine itself. The attraction of the armature c by the magnet A causes the closure of the circuit 9 g; that of the armature c' causes the closure of 9 h, while 9 i is closed by the attraction of the armature c^2. It is evident that g, h, and i might be connected directly to the conductor 2 instead of reaching it through a wire, k. In this case, also, a magnet, M, in a derived circuit, $m\ m$, is used to close a shunt-circuit around the resistance R.

The form shown in Fig. 5 is similar to the preceding, except that now the magnets A B C are placed in a multiple-arc circuit, 7 8, and the circuits through the field are completed through the back instead of the front contacts of the armature, as before explained.

What I claim is—

1. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple-arc circuits therefrom, of a series of independent devices operated by the current generated and arranged to act successively as more translating devices are placed in circuit to increase the current energizing the field-magnet of the generator, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple-arc circuits therefrom, of a series of electro-magnets energized by the current generated and arranged to operate successively as more translating devices are placed in circuit to close circuits, whereby the current energizing the field-magnet of the generator is increased, substantially as set forth.

3. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple-arc circuits therefrom, of a series of electro-magnets energized by the current generated, and each provided with a pivoted armature-lever, the relation between each magnet and its armature differing from that of each other magnet and armature, as ex-

plained, and circuits, as described, the movement of each armature opening or closing a circuit whose closure increases the current energizing the field-magnet of the generator, substantially as set forth.

4. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple-arc circuits therefrom, of a series of electro-magnets energized by the current generated, and armature therefor, different amounts of current being required to cause each magnet to attract its armature, and circuits and resistances, as described, the movement of each armature causing the throwing of a resistance in or out of the field-circuit, substantially as set forth.

5. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple-arc circuits therefrom, of a series of devices operated by the current generated, and arranged to act successively as more translating devices are placed in circuit to increase the current energizing the field-magnet of the generator, and a device or series of devices, also operated by the current generated, and arranged to act upon an increase of said current to decrease the current affecting the first-mentioned series of devices, thereby decreasing the current in the field-circuit of the generator, substantially as set forth.

6. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple-arc circuits therefrom, of a number of electro-magnets placed in divisions of the main line or in a shunt therefrom, and arranged to act successively as more translating devices are placed in circuit to increase the current energizing the field-magnet of the generator, and an electro-magnet placed in a multiple-arc circuit from the main line, and arranged to act upon an increase of the current generated to close circuits which shall draw off a portion of the current energizing the magnets in the shunt-circuit or divisions of the main line, substantially as set forth.

7. The combination of the following: the field-magnet of a dynamo-electric machine placed in a multiple-arc circuit, the armature of said machine placed in another multiple-arc circuit, lamps or other translating devices placed in other multiple-arc circuits, (all such multiple-arc circuits being derived from the same main conductors,) and a series of independent devices operated by the current generated, and arranged to act successively as more translating devices are placed in circuit to increase the current energizing the said field-magnet, substantially as set forth.

This specification signed and witnessed this 10th day of February, 1882.

THOMAS A. EDISON.

Witnesses:

H. W. SEELY,

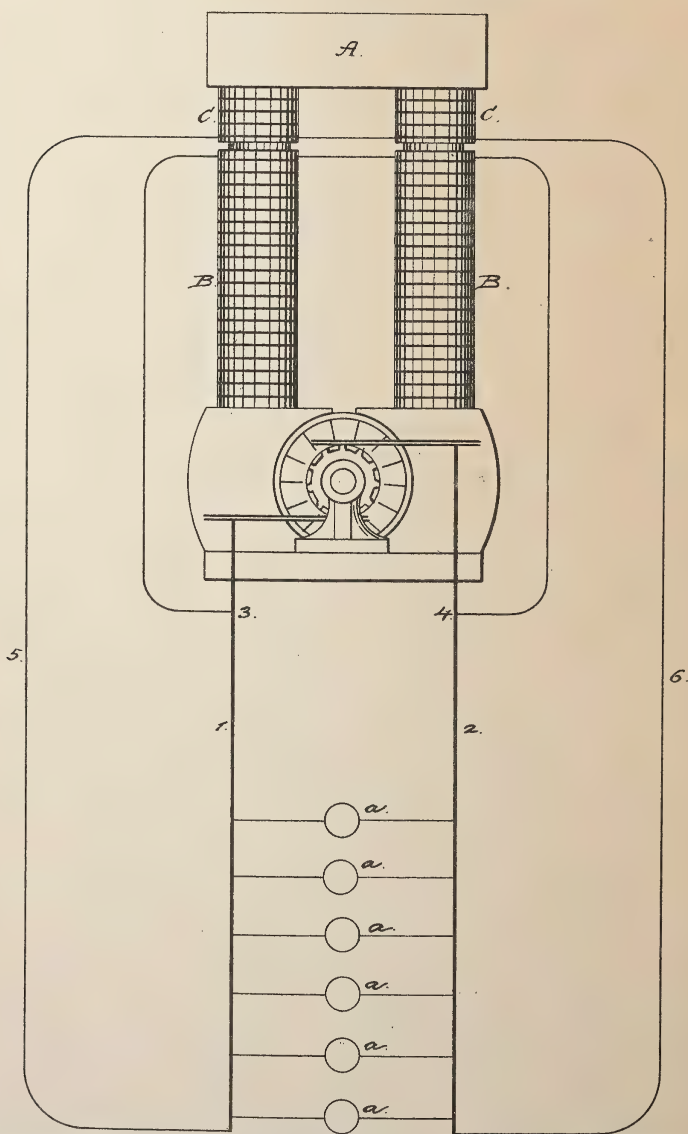
WM. H. MEADOWCROFT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,662. Patented Sept. 19, 1882.



WITNESSES:

E. C. Rowland

H. W. Howard

INVENTOR:

T. A. Edison

BY Rich^d N. Dyer

ATTORNEY.

N. PETERS. Photo-Lithographer. Washington. D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,662, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Regulation of Dynamo or Magneto Electric Machines, (Case No. 410;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of my invention is to produce simple and efficient means for regulating the generation of current by a dynamo or magneto electric machine supplying a multiple-arc system of electrical distribution, according to variations in the number of translating devices in circuit in such system; and my invention consists in winding the field-magnet of the machine in two separate portions, the direction of the winding in one portion being the reverse of that in the other, so that the two parts of the magnet will oppose each other in their attractive energy. The main portion of the wire is included in the field-circuit, which is preferably a multiple-arc circuit from the main conductors of the machine, or which may be supplied from any suitable external source. The oppositely-wound portion is included in another multiple-arc circuit derived from the main conductors. When only a few translating devices are in circuit in the system a large amount of current will pass in this second multiple-arc circuit, which, by opposing the inductive action of the rest of the magnet, allows the generation of only a small amount of current; but as more translating devices are brought into action the current through the reversed coils decreases, and this portion of the magnet becoming less powerful the generation of current increases.

The drawing is a diagram illustrating my invention.

A is the field-magnet of a dynamo-electric machine, each limb of which is wound in two bobbins or sections, B C, the section B being wound in one direction and the section C in the opposite one.

1 2 are the main conductors leading from the machine, and having multiple-arc circuits derived from them, in which are placed lamps or other translating devices, *a a*.

A derived circuit, 3 4, includes the portions B B of the field-magnet coils, and a derived circuit, 5 6, the portions C C, the latter starting from a point beyond the translating devices.

The operation of these circuits is as before explained.

What I claim is—

1. A dynamo or magneto electric machine having a small portion of its field-magnet so wound as to oppose the action of the main portion, in combination with means for varying the current passing in said smaller portion according to the number of translating devices in circuit, whereby the generative capacity of the machine is regulated, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of a multiple-arc circuit from said machine, including a portion of the coils of its field-magnet, such portion being arranged to have a circuit in a direction opposite to that of the coils included in the primary field-circuit, substantially as and for the purpose set forth.

3. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of a multiple-arc circuit including the main portion of its field-magnet coils and another multiple-arc circuit including the remaining portion, these two portions being arranged to have their currents in opposite directions, substantially as and for the purpose set forth.

This specification signed and witnessed this 1st day of May, 1882.

THOMAS A. EDISON.

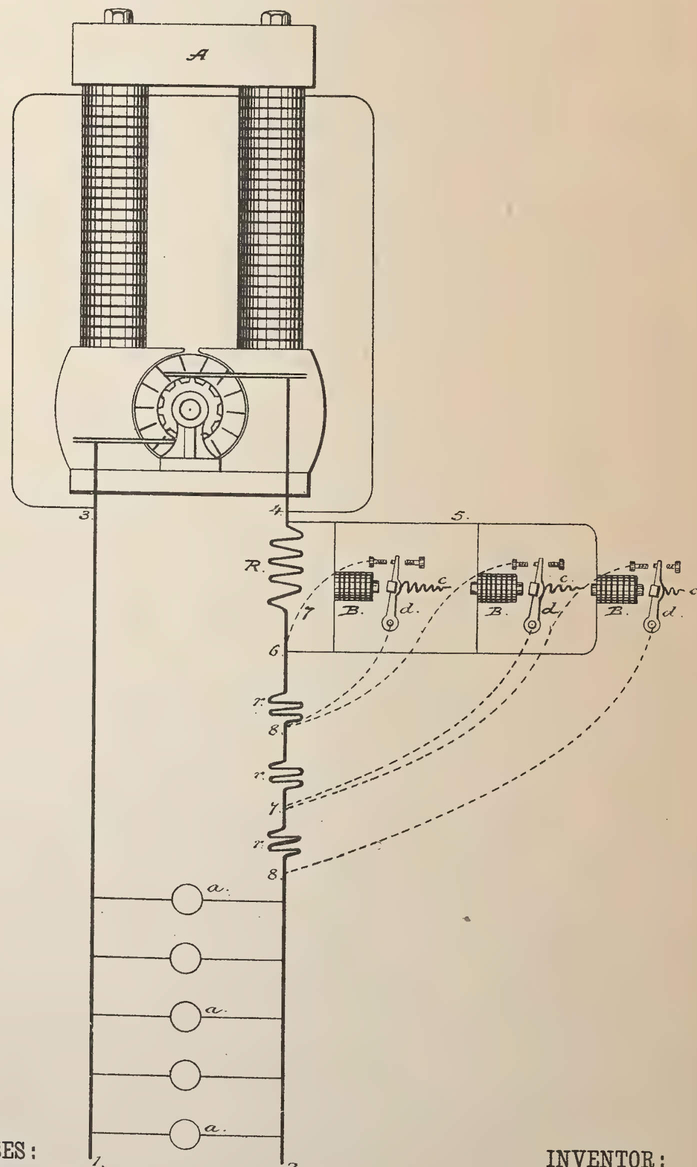
Witnesses:
H. W. SEELY,
P. B. WILBER.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,663. Patented Sept. 19, 1882.



WITNESSES:
E. C. Rowland
F. W. Howard

INVENTOR:
T. A. Edison
BY Richd. N. Dyer,
ATTORNEY.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,663, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Regulation of Dynamo or Magneto Electric Machines, (Case No. 411;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of this invention is to produce means for regulating the generation of current by a dynamo or magneto electric machine by automatically varying the resistance of the main circuit leading therefrom, according to variations in the number of translating devices in circuit in the multiple-arc system supplied by the machine. To do this I place in one or both of the main conductors a series of resistances, around each of which is formed a shunt-circuit, a portion of which is formed by a pivoted armature-lever. Each of these armature-levers is actuated by an electro-magnet, and these electro-magnets are preferably placed in multiple arc across a shunt-circuit around another resistance in the main line, though they might be placed in series in such shunt. The armature-levers are retracted by springs, the springs of the different levers varying in strength; or other means may be provided whereby different amounts of current will be required to cause each magnet to attract its armature, such as placing each armature at a different distance from its magnet, winding the magnets in different ways, &c. The forward movement of an armature closes the shunt-circuit in which it is placed, and so cuts out of circuit one of the resistances in the main line. When the number of translating devices in circuit is increased the current in the shunt-circuit, which contains the magnets, becomes greater, and one or more of the magnets attracts its armature, which, being drawn forward against a contact-point, short-circuits a resistance in the main line, and thereby allows a greater amount of current to pass from the machine to the translating devices supplied thereby. This may be better comprehended by reference to the annexed drawing, which illustrates my invention diagrammatically.

A is the field-magnet of a dynamo-electric machine, energized by the derived circuit 3 4 from the main conductors 1 2. On these main conductors electric lamps or other translating devices, *a a*, are placed in multiple arc. A resistance, R, is placed in the main conductor 2, around which is formed a shunt, 5 6. In multiple-arc circuits across this shunt are placed electro-magnets B B B, each having an armature, *d*, retracted by a spring, *c*, the springs differing in tension. Each armature is included in a shunt-circuit, 7 8, around a resistance, *r*, in the main line. As more and more translating devices are placed in circuit the armatures *d* are successively drawn forward by the increased energy of their magnets B, and the resistances *r r* are successively thrown out of circuit. A reverse operation takes place as the number of translating devices is decreased.

What I claim is—

1. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of a series of resistances in the main circuit from said generator and a number of independent devices actuated by the current generated, for successively throwing such resistances into or out of circuit, according to variations in the number of said translating devices, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of a series of resistances in the main circuit and a series of electro-magnets in a shunt from said main circuit, each magnet being provided with an armature-lever, the motion of which opens and closes a shunt around one of the said resistances in the main line, and the armatures being so arranged as to operate successively, substantially as set forth.

This specification signed and witnessed this 1st day of May, 1882.

THOMAS A. EDISON.

Witnesses:
H. W. SEELY,
P. B. WILBER.

(No Model.)

T. A. EDISON.

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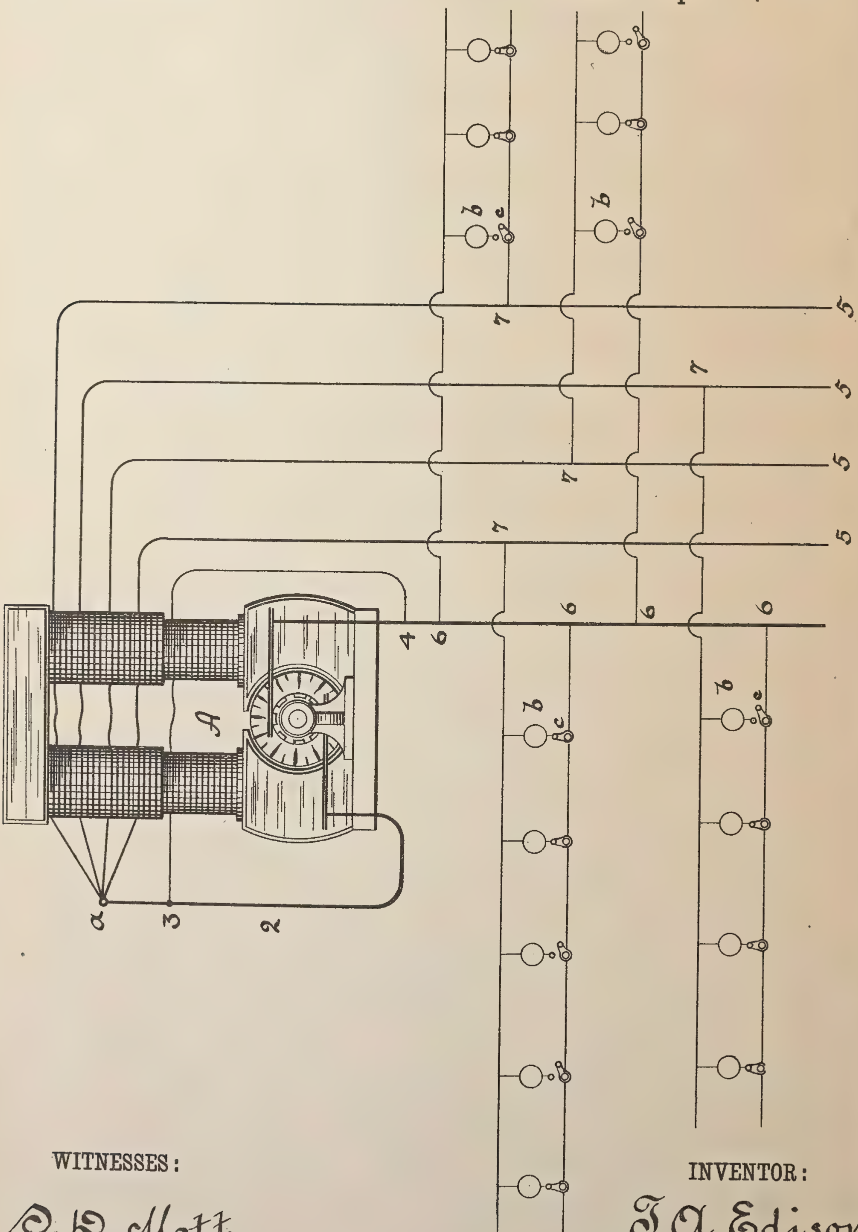

WITNESSES:

S. D. Mott
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INVENTOR:

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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,664, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulating the Generative Capacity of Dynamo or Magneto Electric Machines, (Case No. 393;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object I have in view is to produce simple and efficient means for regulating the generative capacity of a dynamo or magneto electric machine, which will be wholly dependent upon and controlled by the throwing in and out of the translating devices, arranged in multiple-arc or derived circuits, without the use of actuating mechanism other than the usual circuit-controllers at the individual translating devices.

This invention is an improvement upon that described in my Patent No. 248,422, in which only part of the current furnished the lamps passes through the circuit of the field-magnet, and circuit-controllers, in addition to the usual ones at the individual translating devices, are employed to make and break separate field-circuits.

In carrying out the present invention one of the main conductors is divided into a number of parts, each of which parts is connected with bobbins on the limbs of the field-magnet between the commutator-brush and the lamp-circuits. Between each part of the divided conductor and the undivided main conductor is located one set of conductors in multiple-arc or derived circuits, from which last conductors the lamps or other translating devices are arranged; but a number of such sets of conductors may be connected with each part of the divided main conductor; or the separate lamp-circuits may be connected directly with each part of such divided main conductor. In addition to the bobbins spoken of, a portion of the field-magnet is wound with wire, which forms part of a field circuit, which has such resistance produced by the winding itself or by extra resistance as to supply only a small amount of current, enough to primarily energize the magnets. This circuit is preferably a derived or multiple-arc circuit from the main conductors; but it may be one supplied from a battery, a dynamo or magneto electric machine, or other external source. When the multiple-arc circuits of part or all of the translating devices connected with any division of the main conductor are closed by the usual circuit-controllers the current flowing through them will also flow through the bobbins of the field-magnet connected with the particular division of the main conductor, and the energy of the field-magnet will be increased in direct proportion to the number of translating devices in circuit, and as the other divisions are closed by the addition of other lamps or groups of lamps the field-magnet becomes more and more energized, increasing to the desired extent the electro-motive force of the machine. This may be better understood by reference to the drawing, which is a diagrammatic view of a dynamo-electric machine with its circuits.

A is the field-magnet of the machine, and 1 2 are the main conductors leading therefrom. 3 4 is the field-circuit of constant resistance. At the point *a* the main conductor 2 is divided into a number of conductors, 5 5, each of which includes a portion of the coils of the field-magnet A. From each of the circuits 1 5 a circuit, 6 7, is derived, on which translating devices *b b*, having the usual circuit-controllers, *c*, are placed in multiple arc.

It is evident that as fast as more translating devices or groups thereof are placed in circuit the current will pass through a greater portion of the coils of the field-magnet, and the latter will therefore be more and more energized.

I do not claim broadly the combination, with a multiple-arc system of electric lighting, of a portion of the coils of the field-magnet formed by one of the main conductors, as this forms the subject-matter of a claim in application No. 68,621 of even date herewith.

What I claim is—

1. The combination, with a dynamo or magneto electric machine, of a divided main conductor therefrom, each division of which includes a portion of the coils of the field-magnet of the machine, and forms, with the other main conductor, a circuit on which translating devices are placed in multiple arc, substantially as set forth.

2. The combination, with a multiple-arc cir-

cuit of constant resistance from the main conductors of a dynamo or magneto electric machine for primarily energizing the field-magnet of such machine, of the divisions of one of such main conductors, each including a portion of the coils of said field-magnet for increasing the strength of the same, substantially as set forth.

3. The combination of a multiple-arc circuit containing a portion of the coils of the field-magnet of a dynamo-electric machine, a multiple-arc circuit containing the armature of said machine, multiple-arc circuits containing groups of translating devices, (all such multiple-arc circuits being derived from the same main conductors,) and a portion of the coils of the field-magnet formed by divisions of one of such main conductors, substantially as set forth.

This specification signed and witnessed this 10th day of February, 1882.

THOMAS A. EDISON.

Witnesses:

H. W. SEELY,

WM. H. MEADOWCROFT.

(No Model.)

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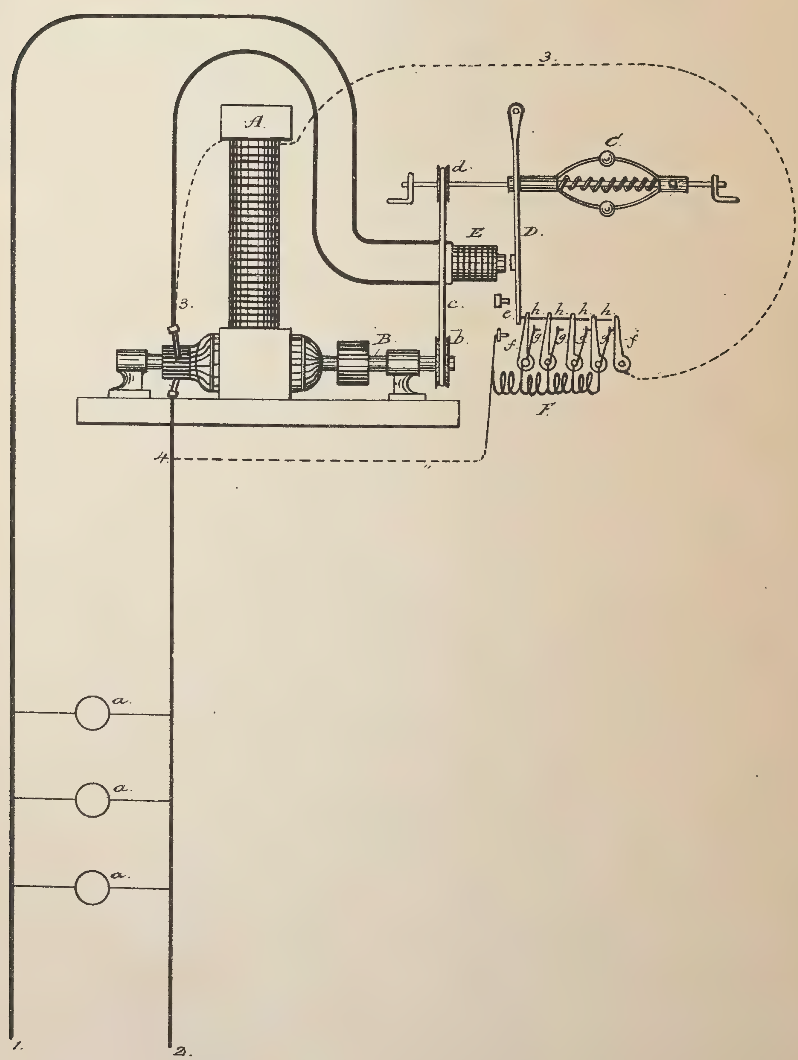

WITNESSES:

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SPECIFICATION forming part of Letters Patent No. 264,665, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Regulation of Dynamo or Magneto Electric Machines, (Case No. 414;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of this invention is to produce a regulating apparatus for dynamo and magneto electric machines which shall regulate the generation of current either for variations in the number of translating devices in circuit from the machine or for variations in the speed of the steam-engine or other motor used to rotate the armature of the machine. Such apparatus consists, generally speaking, of an adjustable resistance in the field-circuit of the machine and a movable arm, by means of which portions of such resistance are placed in or taken out of circuit, the means for moving such arm being, first, a centrifugal governor attached to and operated by any moving part of the generating apparatus, thus regulating for variations of speed; and, second, an electro-magnet placed directly in the main circuit from the generator, or else in a shunt therefrom, and in such position as to attract the movable arm when sufficiently energized.

A convenient form of my invention is shown diagrammatically in the accompanying drawing.

A is a dynamo-electric machine, from which lead main conductors 1 2, having translating devices *a a* arranged upon them in multiple arc. The multiple-arc circuit 3 4 (shown in dotted lines) is the field-circuit energizing the magnet of the machine.

On the armature-shaft B is mounted a pulley, *b*, from which a belt, *c*, passes over the pulley *d* on the shaft of a centrifugal governor, C.

Attached to the governor C, and moved back and forth by it, is an arm, D, whose lower end, *e*, is opposite the free ends of the series of spring-retracted contact-levers *f f*. These open and close circuit at points *g g*, according as they are thrown forward by the arm D or drawn back by their springs, *h h* being pins of insulating material. The adjustable resistance F is connected in the field-circuit of the machine, as shown, so that when an arm, *f*, is in contact with its stop *g* the corresponding portion of the resistance is short-circuited.

Directly in the main circuit 1 2 is placed an electro-magnet, E, the poles of which are opposite the arm D, so that it will attract said arm when sufficiently energized, and thus allow the contact-levers *f f* to make contact with the points *g g*. Normally—that is, when few lamps *a* are in circuit and the engine is running at its proper speed—a portion of the resistance F is in circuit, as shown in the drawing. Should this small number of lamps be still further reduced, the magnet E will weaken and release the arm D, so as to open circuit at more of the points *g* and throw more of the resistance F into the field-circuit; or should the speed of the engine suddenly increase from any cause the same effect would be produced, the drawing up of the governor-balls pulling forward the arm D. Should, however, the number of translating devices in circuit be increased, the energy of the magnet E will also become greater, and the arm D will be drawn back, closing one or more circuits at *g* around portions of the resistance F and properly increasing the energy of the field-magnet. The same effect is produced by a decrease in the speed of the engine actuating the armature, the governor C pushing the arm D back, so as to close circuits around portions of the resistance. It is evident that the governor C could be run from the engine-shaft instead of from that of the armature, or, if desired, from any other moving portion of the apparatus.

The circuit 3 4, instead of being a multiple-arc circuit from the main, could be a shunt therefrom, or a circuit supplied from another dynamo-machine or other suitable external source.

The arrangement of resistances and contact-arms could of course be varied in many ways, if desired.

What I claim is—

1. The combination of a dynamo or magneto electric machine, an adjustable resistance in its field-circuit, a movable arm for varying such resistance, mechanical means connected with and actuated by a moving portion of the ma-

chine or of the motor which drives it, for moving said arm to vary said resistance, and means actuated by the current generated, also for moving said arm to vary the resistance, substantially as set forth.

2. The combination of a dynamo or magneto electric machine, an adjustable resistance in its field-circuit, a movable arm for varying such resistance, mechanical means connected with and actuated by some moving portion of the apparatus for moving said arm to vary the resistance, and an electro-magnet in the main circuit or in a shunt therefrom, also for moving said arm to vary the resistance, substantially as set forth.

3. The combination of a dynamo or magneto electric machine, an adjustable resistance in its field-circuit, a movable arm for varying such resistance, a centrifugal governor connected with and actuated by some moving portion of the apparatus, and also connected with said arm, so as to move it back and forth, and an electro-magnet energized by the current generated, and also adapted to move said arm back and forth, substantially as set forth.

This specification signed and witnessed this 1st day of May, 1882.

THOMAS A. EDISON.

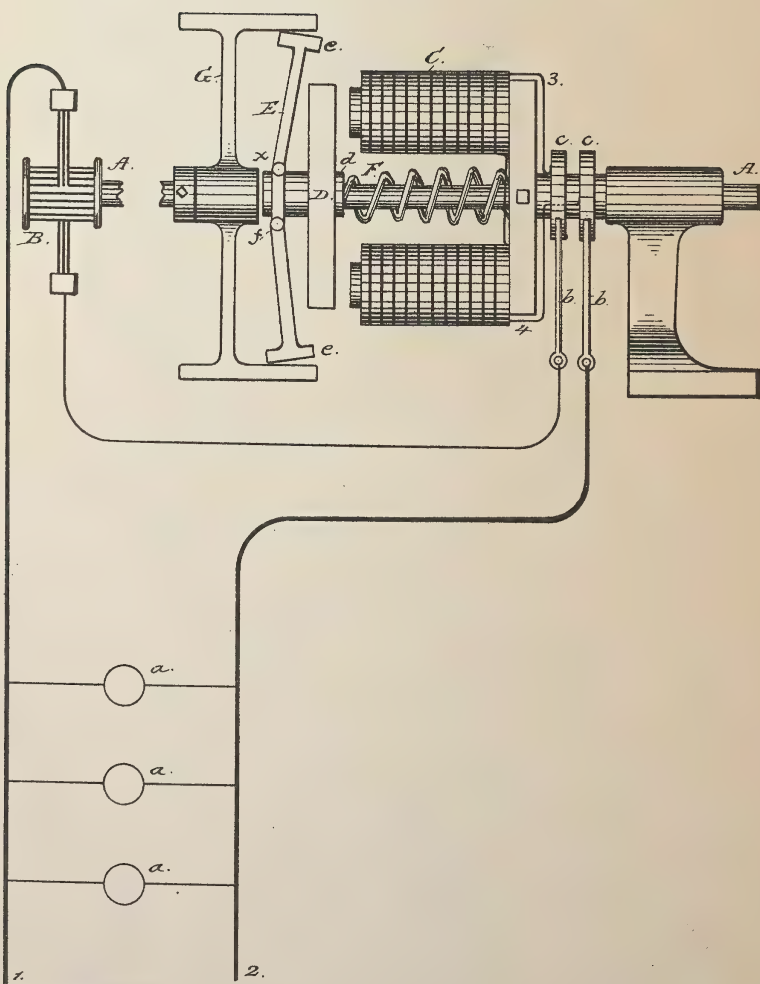
Witnesses:
H. W. SEELY,
P. B. WILBER.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,666. Patented Sept. 19, 1882.



WITNESSES:

E. C. Rowland

F. W. Howard

INVENTOR:

T. A. Edison

BY Rich^d N. Dyer.

ATTORNEY

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,666, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Regulation of Dynamo or Magneto Electric Machines, (Case No. 415;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of my invention is to produce an automatic regulating apparatus for dynamo and magneto electric machines which shall act on variations in the number of translating devices in circuit from the machine, or in the speed of the engine driving said machine, to adjust the speed of rotation of the armature to the point necessary to produce the generation of current required. This I do by connecting the pulley over which the belt from the engine is placed to the armature-shaft through a friction-clutch, the latter being adjustable by means of an electro-magnet energized by the current generated, so as to convey more or less power to the armature-shaft, according to the current required.

A convenient form of my invention is shown in the drawing, which is a view of a regulating apparatus in elevation, with the friction-clutch shown in section and the circuits in diagram.

A is the armature-shaft of a dynamo or magneto electric machine, and B the commutator-cylinder mounted thereon, the armature being omitted for convenience in drawing. 1 2 are the main conductors leading from the commutator, and having translating devices *a a* placed in multiple arc upon them.

C is an electro-magnet, so mounted near the end of the armature-shaft A as to revolve therewith. The conductor 2 is broken and formed into contact-springs *b b*, which bear on the metal collars *c c*, these being insulated from the shaft A. From these metal collars a circuit, 3 4, runs, which includes the magnet C, the latter being thus placed directly in the main circuit 1 2. A sleeve, *d*, is keyed also to the armature-shaft, so that it revolves with it, but has a longitudinal movement upon it, on which sleeve are mounted the armature D of the magnet C and the friction-clutch E. A spring, F, is secured to the sleeve *d*, so that such sleeve is retracted from the magnet by the spring. The friction-clutch consists of arms carrying friction-shoes *e e* and united by a toggle or elbow joint, *f*.

G is the pulley over which the belt from the engine which drives the armature passes. The pulley G is sleeved to the shaft A so as to turn loosely upon it, and motion is therefore communicated from the belt to the shaft only through the friction-clutch, more or less power being communicated, according to the position of the friction-shoes within the pulley G.

The operation of this apparatus is as follows: When more translating devices *a a* are placed in circuit the increased current in the main line causes an increase in the energy of the magnet C, which attracts its armature D, and thus throws the friction-shoes *e e* into greater contact with the pulley G, thereby conveying more power from the engine to the armature-shaft and causing the latter to revolve with greater rapidity, thus increasing the generation of current to the desired degree. A decrease in the number of translating devices in circuit causes a decrease in the energy of the magnet C, the spring F throws the armature back, and the friction-shoes *e e* are partly removed from contact with the pulley. Should a sudden increase occur from any cause in the speed of the engine which drives the armature—an increase too great to be taken up immediately by the governor of the engine—the friction-shoes *e e* will slip on the surface of the pulley, and the increase will not be communicated to the armature-shaft. It is evident that other forms of friction-clutch might be used, though that shown is found most convenient for the purpose.

The magnet C might be placed in a shunt from the main line, instead of directly therein, with the same effect.

What I claim as my invention is—

1. In a dynamo or magneto electric machine, the combination, with the armature-shaft and a loose pulley mounted thereon, of a friction-clutch for conveying motion from said pulley to said shaft, and means actuated by the current generated for moving such friction-clutch so as to vary its contact with the pulley, substantially as set forth.

2. In a dynamo or magneto electric machine, the combination, with the armature-shaft and a loose pulley mounted thereon, of a friction-clutch for conveying motion from said pulley to said shaft, and an electro-magnet in the main line from the machine for moving such friction-clutch so as to vary its contact with the pulley, substantially as set forth.

3. The combination of the loose pulley on the armature-shaft, the electro-magnet mounted on said shaft and revolving with it, and the sleeve keyed to said shaft and carrying the armature of said electro-magnet, and the friction-clutch making frictional contact with the inside of said pulley, substantially as set forth.

This specification signed and witnessed this 1st day of May, 1882.

THOS. A. EDISON.

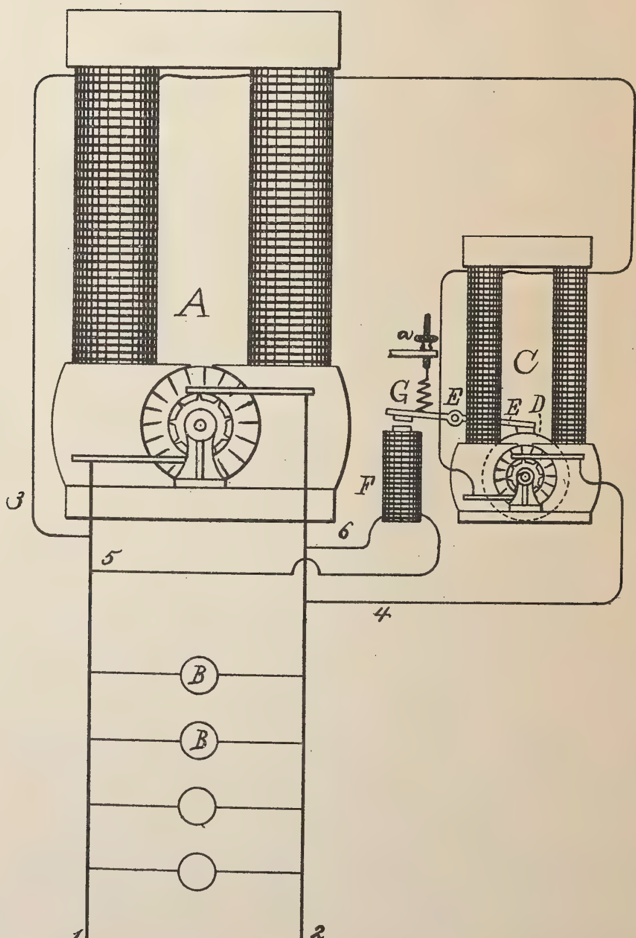
Witnesses:
H. W. SEELY,
P. B. WILBER.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,667. Patented Sept. 19, 1882.



WITNESSES:
E. C. Rowlands
H W Seely

INVENTOR:
T. A. Edison
BY Richd. N. Dyer.
ATTORNEY.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,667, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Regulating Electrical Generators, (Case No. 425;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This invention relates to means for regulating the generative capacity of a dynamo or magneto electric machine by throwing into the circuit of the field-magnet a variable and controllable counter electro-motive force, and is an improvement upon the special means for this purpose described in my Patent No. 248,421.

The object I have in view is to produce a simple and efficient mechanism operating upon this principle which will regulate both for variations in the speed of the engine and in the number of translating devices. This I accomplish by arranging a motor directly in the field-circuit, and by regulating it or controlling its regulation by an electro-magnet arranged in multiple arc, so that it will be affected both by variations in speed and in number of translating devices. A friction-brake is arranged to bear upon a large wheel located directly on the shaft of the motor-armature or on a shaft connected with such armature-shaft, and having a higher rate of speed than the armature-shaft. This friction-brake is forced upon the wheel by a spring or weight, which is made adjustable to give more or less pressure normally, so that the candle-power of the lamps can be adjusted. The magnet arranged in multiple arc from the main conductors of the machine operates against the spring or weight, and tends to relieve the pressure of the brake and allow the motor to run with greater speed and throw a greater counter electro-motive force into the field-circuit, thereby weakening the field-magnet. As the magnet grows weaker it allows the spring or weight to force the brake with greater pressure upon the wheel, reducing the speed of the motor and the counter electro-motive force generated by it. The electro-magnet which opposes the action of the spring or weight of the brake may be placed in a local circuit, as in a shunt from the main line or from the field-circuit, and have its circuit closed and opened by the armature of a controlling relay-magnet placed in a multiple-arc circuit from the main conductors. The electro-magnet in the multiple-arc circuit being affected in the same way as are the lamps by changes in speed and in number of lamps, the local circuit will be opened and closed accordingly, and the regulation will be efficient in all respects.

The foregoing will be better understood from the drawing, which is a view, partly diagrammatic, of apparatus embodying the invention.

A is a dynamo or magneto electric machine, from which run the main conductors 1 2 in multiple-arc circuits, from which are located the lamps or other translating devices, B. The field-circuit 3 4 of A is preferably a multiple-arc circuit from 1 2, and in it is located the electro-dynamic motor C. Upon the armature-shaft of the motor is a large wheel, D, upon which bears a pivoted brake-lever, E. This lever, at its other end, carries an armature attracted by an electro-magnet, F, located in a multiple-arc circuit, 5 6, from the main conductors 1 2. The brake-lever is lifted off of the brake-wheel by the attraction of this electro magnet, the force of which is opposed by a spring, G, made adjustable in its tension by a nut, *a*, or other suitable means, so that the candle-power of the lamps can be adjusted. If the magnet F were in a local circuit controlled by a relay-magnet arranged in multiple arc, as before explained, and as shown in Fig. 2 of Case No. 68,628, of even date herewith, the means for adjusting the candle-power would be used in connection with the relay-magnet.

What I claim is—

1. The combination, with a dynamo or magneto electric machine, of an electromotor located in the field-circuit and varying the strength of the field-magnet by variations in its counter electro-motive force, and an electro-magnet arranged in a multiple-arc circuit from the conductors of the generator, for controlling the speed of the motor, whereby the generator will be regulated to meet changes in speed, as well as the varying conditions of the external circuit, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine, of an electromotor located in its field-circuit and adjustable means for regulating or controlling the speed of such motor, substantially as set forth.

3. The combination, with a dynamo or magneto electric machine, of an electromotor located in its field-circuit and a friction-brake controlled by an electro-magnet for regulating the speed of such motor, substantially as set forth.

4. The combination, with a dynamo or magneto electric machine, of an electromotor located in its field-circuit, a friction-brake forced by a spring or weight upon a wheel mounted upon or connected with the motor-shaft, and an electro-magnet opposing the action of such spring or weight and located in a multiple-arc circuit from the main conductors of the generator, substantially as set forth.

This specification signed and witnessed this 22d day of May, 1882.

THOMAS A. EDISON.

Witnesses:

EDUARD C. ROWLAND,

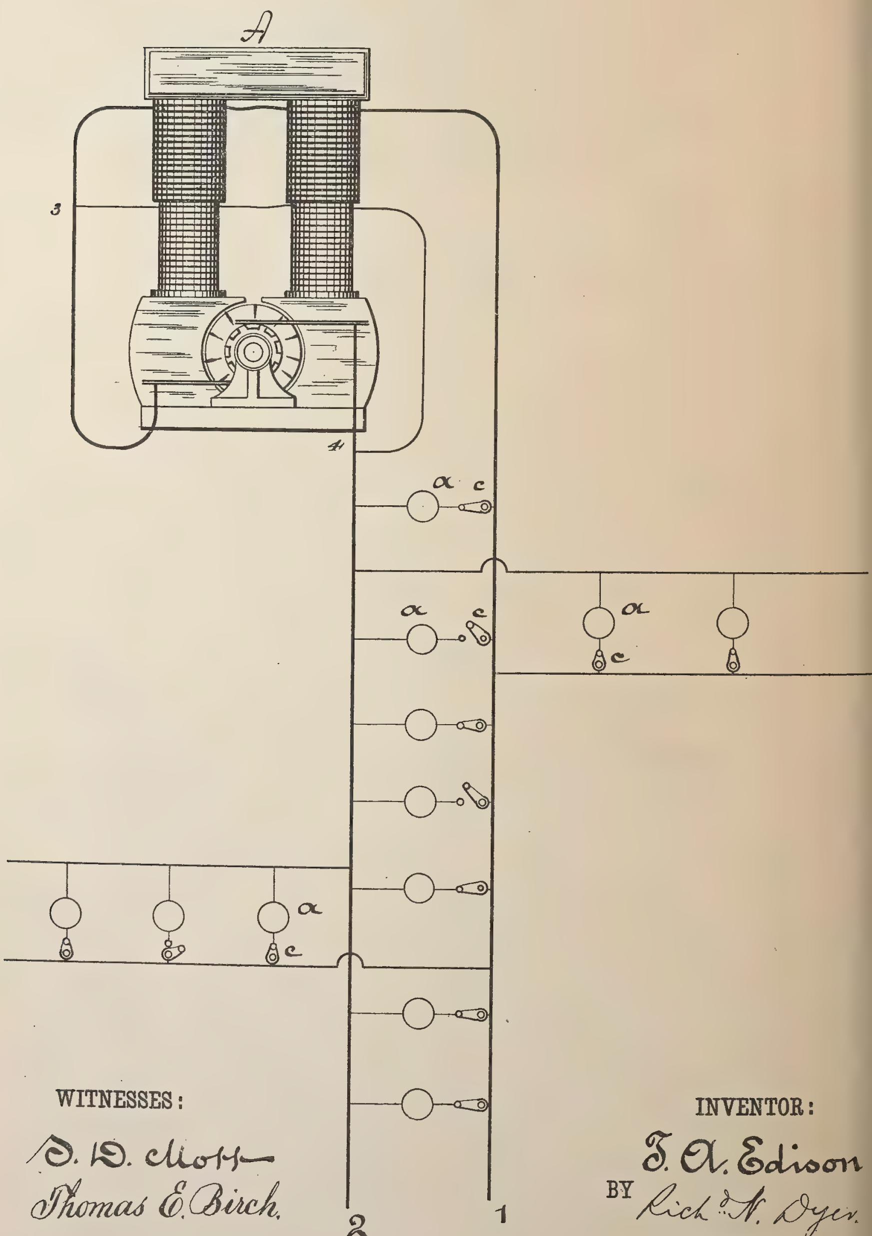
C. P. MOTT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,668. Patented Sept. 19, 1882.



WITNESSES:

D. D. Mott

Thomas E. Birch.

INVENTOR:

T. A. Edison

BY Richd N. Dyer.

ATTORNEY

N. PETERS, Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,668, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulating the Generative Capacity of Dynamo-Electric Machines, (Case No. 398;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to produce means by which the addition or removal of translating devices in the multiple-arc circuits of a system of electrical distribution shall cause immediately a proper regulation of the current energizing the field-magnet of the dynamo-electric machine supplying such system, and this without the use of adjustable resistances, or of any mechanism whatever, except the ordinary circuit-controllers of the lamps.

The drawing is a diagram illustrating views of my invention.

A is a dynamo-electric machine, from which lead the main conductors 1 2, in multiple-arc circuits from which are placed lamps or other translating devices, *a*, each provided with a circuit-controller, *c*. The lower portion of the field-magnet of the generator A is wound with wire, forming part of a multiple-arc circuit, 3 4, from the main conductors 1 2. This circuit is of high resistance, so that only a small amount of current sufficient to primarily energize the field-magnet will pass through it. It may, if desired, be a circuit supplied from an external source instead of from the conductors 1 2. The main conductor 1 is brought up on one side and wound around the magnet, afterward extending out parallel with the conductor 2. When translating devices are first put in circuit the magnet is sufficiently energized by means of the circuit 3 4; but as their number is increased the resistance of the main circuit is lowered, so that more current flows through the conductor 1 and the magnet becomes more and more energized. As devices are thrown out and the resistance of the main circuit increases, the energy of the magnet is lessened by the decrease of current in the conductor 1.

It will thus be seen that the regulation of the machine is accomplished instantly and automatically by the throwing in and out of circuit of single translating devices, the addition or removal of each device having an immediate effect on the current passing through the field-magnet.

What I claim is—

1. The combination, with a dynamo-electric machine and translating devices arranged in multiple arc, of a field-circuit of constant resistance for primarily energizing the field-magnet, and another field-circuit whose resistance is varied by the addition and removal of translating devices, substantially as set forth.

2. The combination, with a dynamo-electric machine, of one of its main conductors forming a portion of the coils of its field-magnet, a circuit for primarily energizing such field-magnet, and translating devices arranged in multiple-arc or derived circuits, whereby the addition of each individual translating device causes a corresponding increase in the energy of the field-magnet, substantially as set forth.

3. The combination of a multiple-arc circuit containing a portion of the coils of the field-magnet of a dynamo-electric machine, a multiple-arc circuit containing the armature of said machine, and multiple-arc circuits containing lamps or other translating devices, all such multiple-arc circuits being derived from the same main conductors, and another field-circuit whose resistance is varied by the addition and removal of translating devices, whereby the addition or removal of any translating device causes an instant and corresponding regulation of the current energizing the field-magnet of the machine, substantially as set forth.

This specification signed and witnessed this 10th day of February, 1882.

THOMAS A. EDISON.

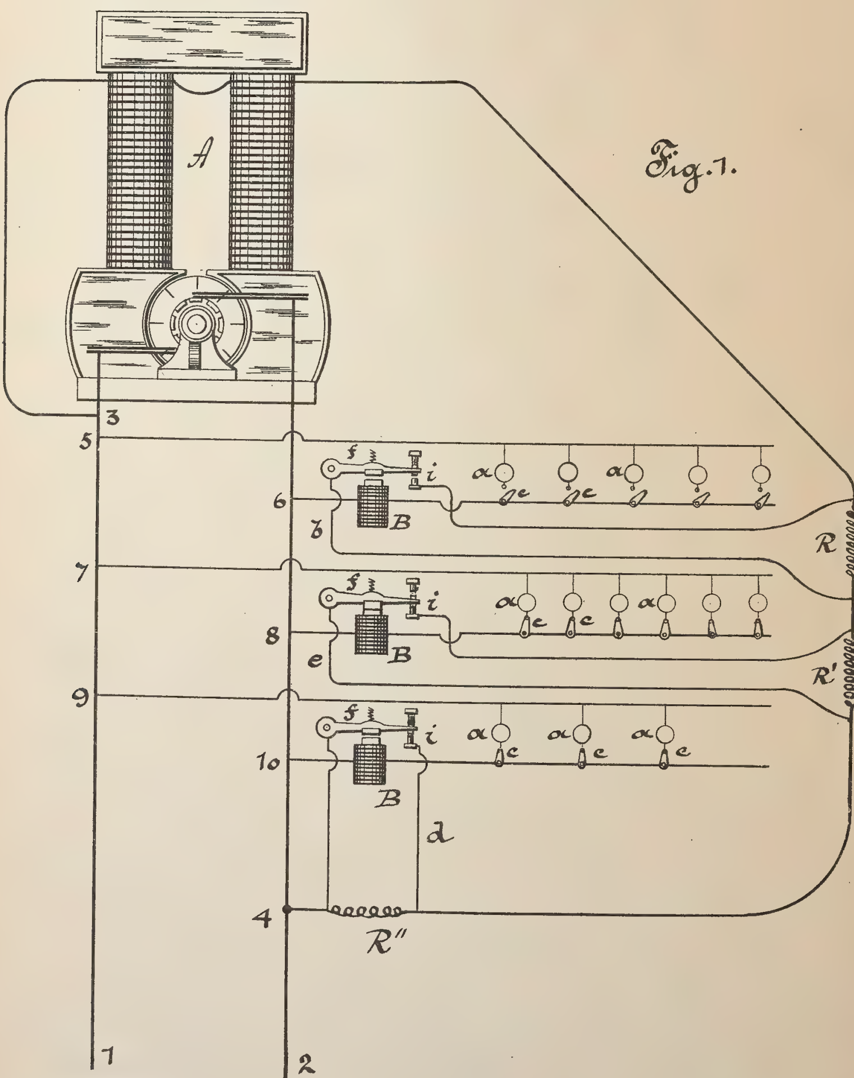
Witnesses:
H. W. SEELY,
SAMUEL INSULL.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,669. Patented Sept. 19, 1882.



WITNESSES:

Thomas E. Birch

S. D. Moss

INVENTOR:

T. A. Edison

BY Richd. N. Dyer,

ATTORNEY.

N. PETERS, Photo-Lithographer, Washington, D. C.

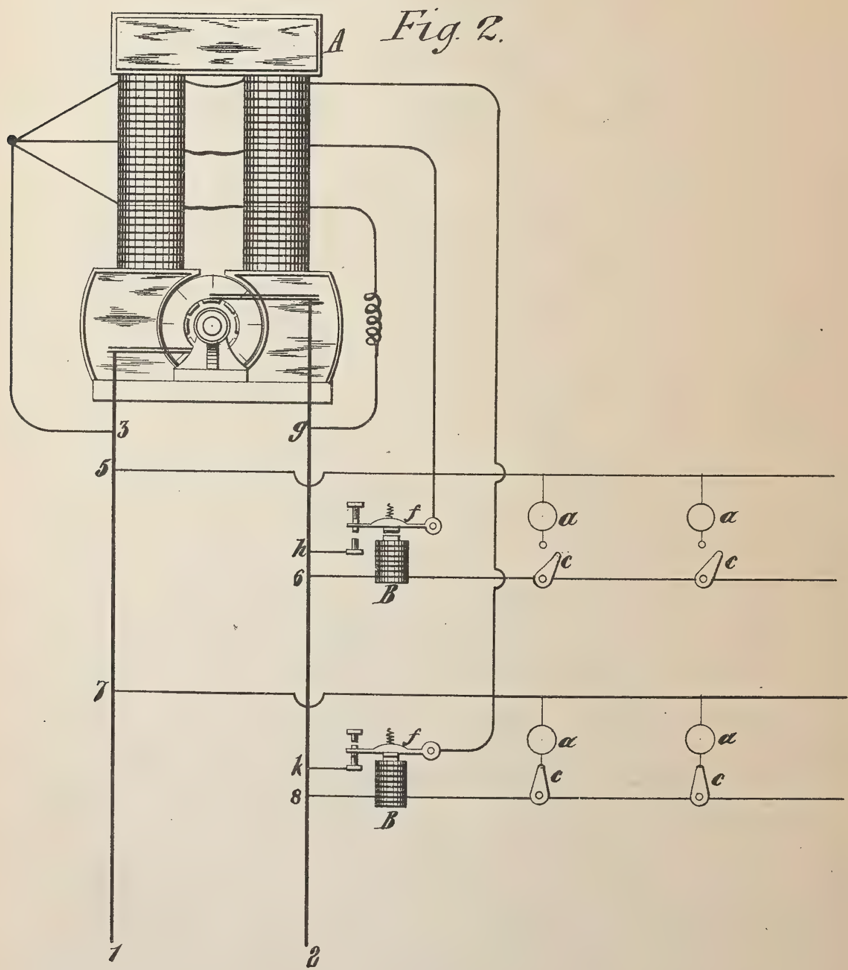
(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,669. Patented Sept. 19, 1882.

Fig. 2.



WITNESSES:

Thomas E. Birch.

D. D. Mott

INVENTOR:

T. A. Edison

BY Richd. N. Dyer,

ATTORNEY.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,669, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Regulating the Generative Capacity of Dynamo or Magneto Electric Machines, (Case No. 395;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to furnish simple and efficient means whereby the addition or removal of translating devices in a multiple-arc system of electrical distribution will automatically vary the current energizing the field-magnet of the dynamo or magneto electric machine supplying such system. From the main conductors which lead from the machine multiple-arc circuits are run, across which are placed lamps, also in multiple arc. Separate groups of translating devices are thus formed. In each of the multiple-arc circuits from the mains is placed an electro-magnet, provided with a pivoted armature-lever retracted by a spring, which acts to open and close a circuit, which, by its closure, causes more current to pass through the field-magnet, such circuit being either a shunt around a resistance in the field-circuit or a division of the field-circuit, including a portion of the coils of the field-magnet.

In the annexed drawings, Figure 1 is a diagram showing the arrangement in which the magnet cuts out resistance from the field, and Fig. 2 a diagram showing that in which additional circuits are closed through the field-coils.

While the invention is here shown as applied to a dynamo-electric machine, it is evident that it is equally applicable to magneto-electric machines in which the field-circuit is supplied with current from an external source, such as another magneto or dynamo machine or a battery.

A is a dynamo-electric machine, and 1 2 are the main conductors leading therefrom.

3 4 is the multiple-arc circuit energizing the field magnet of the machine.

5 6, 7 8, and 9 10 are multiple-arc circuits from the main line, containing lamps or other translating devices, *a a*, each of which is provided with a circuit-controller, *c*.

R R′ R″ are resistances placed in the circuit 3 4. Shunt-circuits *b d e* are formed around these resistances. A part of each shunt-circuit consists of an armature-lever, *f*, controlled by an electro-magnet, B, placed in the multiple-arc circuit containing lamps *a*. It is evident that when these shunt-circuits are all closed at *i i* none of the resistances will be in the field-circuit, and when these shunts are open all the resistances R R′ R″ will be in circuit. All the lamp-circuits in the multiple-arc circuit 5 6 being open, no current flows through the magnet of that circuit, and the shunt-circuit *b* is therefore open at *i*, so that the resistance R is in the field-circuit; but in the circuit 7 8 a number of lamps are on, and sufficient current passes through the circuit to cause the armature *f* to be attracted, closing the shunt *e*, thus short-circuiting the resistance R′. While in the circuit 9 10, though a few lamps are on, yet they are not enough to cause the passage of sufficient current to energize the magnet B enough to close the shunt *d* and cut out the resistance R″.

In Fig. 2 the coils of the field-magnet of the dynamo-electric machine A are divided into a number of parts or bobbins, each of which is included in a division of a multiple-arc circuit from the main conductors 1 2. One of these divisions, 3 *g*, returns directly to the main conductor 2, being intended as a circuit for primarily energizing the field, and is made of high resistance, either by the fineness of its wire or by a resistance placed in it, so that only a small amount of current will pass through it. Each of the other divisions, 3 *h* and 3 *k*, of the field-circuit includes an armature-lever, *f*, which is actuated, according to the current flowing through its magnet B, to make or break the circuit in which it is placed. Thus, when a circuit through a magnet, B, is closed by the addition of a sufficient number of translating devices it attracts its armature-lever and closes a circuit through a greater portion of the field-magnet coils.

What I claim is—

1. The combination, with a dynamo or magneto electric machine and groups of translating devices arranged in multiple arc upon multiple-arc circuits from the main conductors of such machine, of means other than the cir-

cuit-connections in connection with each group for regulating the current energizing the field-magnet of the machine, acting automatically upon the addition or removal of translating devices in the group, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine and groups of translating devices, arranged as described, of means in connection with each group, operated automatically by the current, whereby the addition or removal of translating devices in the group causes the closing or opening of a circuit, whose closure or opening varies the current energizing the field-magnet of the generator, substantially as set forth.

3. The combination, with a series of resistances in the field-circuit of a dynamo or magneto electric machine and a number of groups of translating devices, arranged as described, of means in connection with each group, operated automatically by the addition or removal of translating devices in such group, for throwing one of said series of resistance in or out of circuit, substantially as set forth.

4. The combination, with a dynamo or magneto electric machine and groups of translating devices, arranged as described, of a magnet energized by the current supplying each group and provided with an armature-lever whose motion opens or closes a circuit to vary the current energizing the field-magnets of said machine, substantially as set forth.

5. The combination of the field-magnet of a dynamo-electric machine placed in a multiple-arc circuit, the armature of said machine placed in another multiple-arc circuit, groups of translating devices placed in other multiple-arc circuits, said multiple-arc circuits being all derived from the same main conductors, and means in connection with each group for regulating the current energizing the field-magnet of the machine, acting automatically upon the addition or removal of translating devices in the group, substantially as set forth.

This specification signed and witnessed this 10th day of February, 1882.

THOMAS A. EDISON.

Witnesses:

H. W. SEELY,

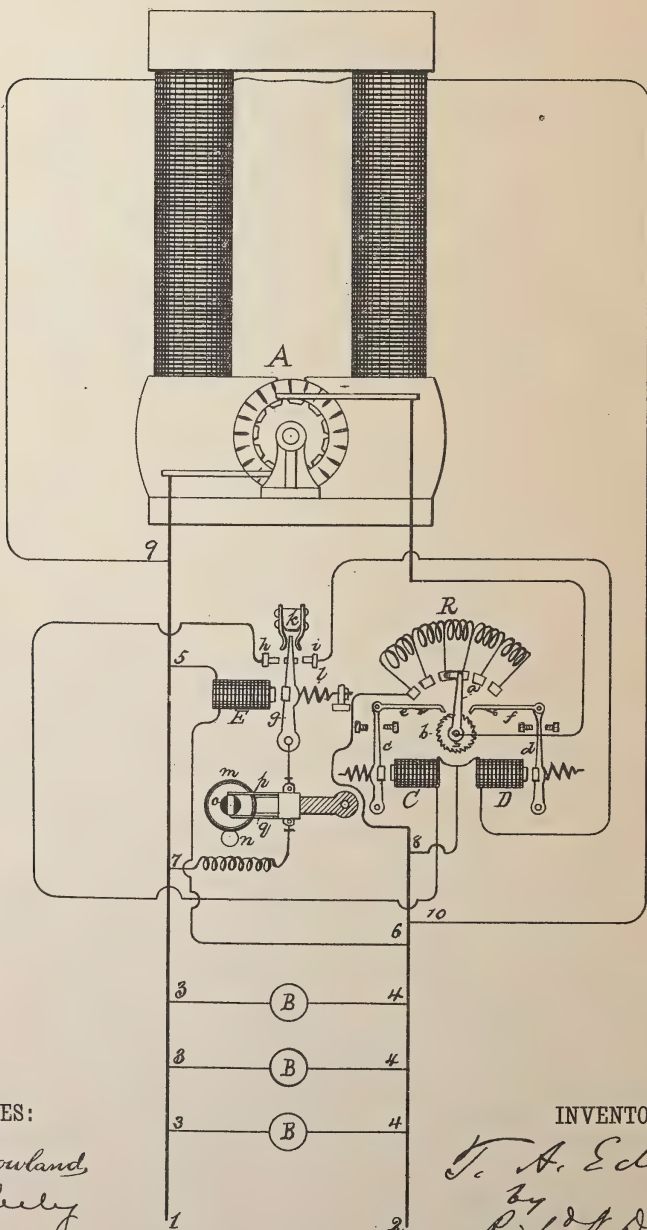
WM. H. MEADOWCROFT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,670. Patented Sept. 19, 1882.



WITNESSES:

E. C. Rowland,
H. W. Seely

INVENTOR:

T. A. Edison
by
Richd. N. Dyer,
atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,670, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Regulating Electrical Generators, (Case No. 442;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object I have in view is to produce simple and efficient means for automatically regulating the generative capacity of dynamo or magneto electric machines supplying lamps or motors arranged in multiple arc, which means will regulate both for changes in the speed of the engine, as well as in the number of translating devices, and will keep the candle-power of the lamps constant and prevent flicker. This I accomplish by providing a mechanism operated by the current generated and throwing resistance into and out of one of the main conductors. This mechanism is controlled by an electro-magnet located in a multiple-arc circuit beyond the resistance, and affected exactly as are the lamps themselves by changes in the speed of the engine and in the number of lamps or motors in circuit, and also by the throwing in and out of the resistance. When the lever of this magnet makes its forward contact a circuit is completed through the resistance-adjusting mechanism and resistance is thrown into the main line or conductor, and when this lever makes its back contact another circuit through the resistance-adjusting mechanism is completed and resistance is cut out of the main line. When the candle-power is normal the lever of the controlling electro-magnet is held in a central position by spring-fingers or equivalent means. The resistance-adjusting mechanism is composed of two electro-magnets, whose armature-levers carry pawls engaging with two ratchet-wheels, the forward movement of which throws the contact-arm in opposite directions. The divided circuit running through these electro-magnets may be a multiple-arc circuit, a shunt-circuit, or other circuit having always, when closed, sufficient energy to work the mechanism. This circuit passes through a circuit-breaker common to both magnets, which is preferably a mechanical circuit-breaker operated by some moving part, and may be a wheel riding on the armature-shaft and carrying a circuit-breaking cylinder, or there may be two circuit-breakers operated in this way—one for each electro-magnet. The field-circuit of the generator is also a multiple-arc circuit from the main conductors, and is connected with such main conductors beyond the resistance, so that it will be affected by such resistance, like the lamps, and will receive more current when resistance is cut out of the main line and less current when resistance is thrown into the main line.

The foregoing will be better understood from the drawing, which is a view, partly diagrammatic, of apparatus embodying the invention.

A is a dynamo or magneto electric machine, from which run the main conductors, 1 2, in multiple-arc circuits 3 4 from which are arranged the lamps or motors B.

R is the resistance, located in either 1 or 2, between the lamps and the generator. This resistance is thrown into and out of circuit by the arm *a*, which is moved in one or the other direction by two ratchet-wheels, one of which is shown at *b*.

C D are electro-magnets, the armature-levers *c d* of which carry pawls *e f*, working the ratchet-wheels.

E is an electro-magnet in a multiple-arc circuit, 5 6, connected with 1 2 beyond the resistance R. Its armature-lever *g* is in another multiple-arc circuit, 7 8, which is divided at the front and back contacts, *h i*, of this lever. The divisions of this circuit pass through the coils of the two electro-magnets C D and are again joined. The lever *g* is held in a central position by spring-fingers *k*. The retracting spring *l* of the lever *g* is made adjustable, so that the candle-power of the lamps may be adjusted at this point. The circuit 7 8 has a mechanical circuit-breaker arranged in its line. This may be a wheel, *m*, riding upon the armature-shaft *n*, a detached portion of which is shown for clearness of illustration. The wheel *m* carries a breaking-cylinder, *o*, composed of metal and insulation, upon which cylinder rest spring-fingers *p q*. The circuit-wires run to these spring-fingers, the revolution of the cylinder alternately making and breaking the electrical connection between such fingers.

The field-of-force circuit of the machine is a

multiple-arc circuit, 9 10, from 1 2, the connection being made beyond the resistance R, as shown, for the purpose already explained.

What I claim is—

1. The combination, with a dynamo or magneto electric machine, of translating devices located in multiple-arc circuits from its main conductors, an adjustable resistance in one of such main conductors, an electro-magnet located in a multiple-arc circuit, and mechanism operated or controlled by said electro-magnet for throwing such resistance into and out of the main line, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine and translating devices in multiple arc-circuits, of an adjustable resistance in the main line, an electro-magnet in a multiple-arc circuit, circuits closed at the front and back contacts of the armature-lever of said electro-magnet, and mechanism included in said circuits for throwing such resistance into and out of the main line, substantially as set forth.

3. The combination, with a dynamo or magneto electric machine and translating devices in multiple-arc circuits, of an adjustable resistance in the main line, two electro-magnets, pawl-and-ratchet mechanism worked by such electro-magnets, a contact-arm moved thereby in opposite directions, an electro-magnet in multiple arc, the armature of which closes at its front and back contact a circuit through one or the other of such two electro-magnets, and a circuit breaker or breakers in circuit with said two electro-magnets, substantially as set forth.

4. The combination, with a dynamo or magneto electric machine and translating devices in multiple arc, of an adjustable resistance in the main line, an electro-magnet, and mechanism operated or controlled by said electro-magnet for throwing such resistance into and out of the main line, said electro-magnet being located in a multiple-arc circuit connected with the main conductors beyond such resistance, substantially as set forth.

5. The combination, with a dynamo or magneto electric machine and translating devices in multiple arc, of an adjustable resistance in the main line and the field-of-force circuit of the machine connected with the main conductors beyond such adjustable resistance, substantially as set forth.

6. The combination, with a dynamo or magneto electric machine and translating devices in multiple arc, of an adjustable resistance in the main line, an electro-magnet located in a multiple-arc circuit beyond the resistance, mechanism operated or controlled by said electro-magnet for throwing such resistance into and out of the main line, and the field-of-force circuit of the machine connected with the main conductors beyond such resistance, substantially as set forth.

This specification signed and witnessed this 9th day of June, 1882.

THOS. A. EDISON.

Witnesses:
RICHD. N. DYER,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,671. Patented Sept. 19, 1882.

Fig. 1.

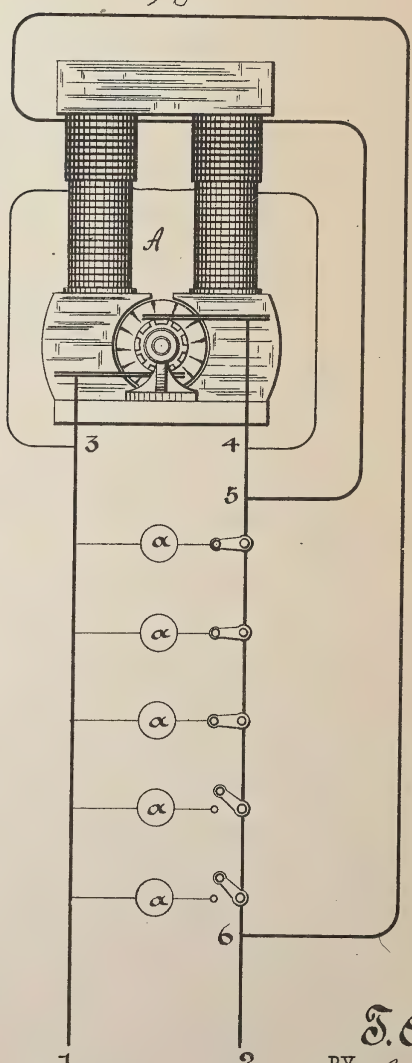
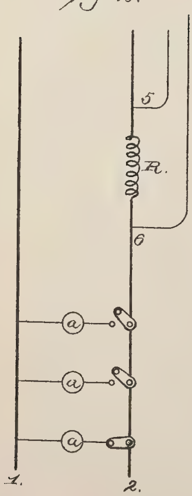


Fig. 2.



WITNESSES:

O. D. Mott.
Thomas E. Birch

INVENTOR:

T. A. Edison

BY Richd. N. Dyer,

ATTORNEY.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,671, dated September 19, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulating the Generative Capacity of Dynamo or Magneto Electric Machines, (Case No. 392;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of my invention is to produce means for regulating the energy of the field-magnet of a dynamo or magneto electric-machine supplying current to a multiple-arc system of electrical distribution, which shall operate automatically on the addition or removal of translating devices, and shall not require any mechanism whatever for varying the strength of the field-circuit.

In carrying my invention into effect the field-magnet is partly wound with wire, the coils being preferably in a multiple-arc circuit from the main line. This circuit has a comparatively high resistance, which remains constant, and may be obtained by the winding itself or by means of an additional resistance placed in the circuit. The resistance of the circuit is such that the requisite electro-motive force will be given only when a few translating devices are in circuit. In addition to this winding, a portion of the magnet is wound with a conductor formed of bunched wires, to give flexibility for winding, preferably equal in conductivity to one of the main conductors leading from the machine, and these coils are in a shunt-circuit from one of the said main conductors, which circuit starts at a point near the machine, preferably between the machine and the first translating device, and returns to the main conductor at a point beyond the farthest translating device. There is of course a difference of potential between these two points, and the greater the number of translating devices between them the greater becomes the difference of potential. When only a few translating devices are in circuit the constant field-circuit energizes the magnet sufficiently; but as more devices are placed in circuit and the electro-motive force becomes too weak the fall of potential at the end of the main line causes a greater amount of current to flow through the shunt, so that the field-magnet becomes stronger and the electro-motive force is increased. If, now, translating devices are removed, the difference of potential becomes less and the field-magnets are weakened by the decrease of current in the shunt. Instead of a shunt-circuit depending upon the drop in pressure on one of the main conductors, a shunt around a resistance placed in one of the main conductors may be used for the field-circuit of the machine. This may be better understood by reference to the drawings, in which—

Figure 1 is a diagrammatic view of the preferred form of connections, and Fig. 2 a view showing modified connections.

A represents the field-magnet, and 1 2 the main circuit therefrom, in which translating devices *a a* are placed in multiple-arc circuits.

3 4 is the constant field-circuit, and 5 6 the shunt-circuit. The wire 3 4 may be wound on a portion of the limbs of the magnet and the wire 5 6 on the remaining portion, as shown; or the wire 3 4 may cover the whole of the cores, while the thicker wire is placed over it. It is evident that the circuit 3 4 could be supplied from an external source, such as a battery or another dynamo or magneto electric machine. The shunt 5 6 may be around a resistance, R, Fig. 2, in 1 or 2.

What I claim is—

1. The combination, with the field-magnet of a dynamo or magneto electric machine and translating devices in multiple-arc or derived circuits from the main conductors thereof, of a shunt-circuit from one of the main conductors for energizing said field-magnet, the current in such shunt being dependent upon the number of translating devices in circuit, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine, of a circuit for primarily energizing the field-magnet and another field-circuit formed by a shunt from one main conductor, the current in which is controlled by the number of translating devices in circuit, for automatically regulating the strength of the field-circuit in direct proportion to the number of translating devices, substantially as set forth.

3. A dynamo or magneto electric machine supplying translating devices arranged in multiple-arc circuits, in combination with a shunt-circuit from one of the main conductors of the machine around the multiple-arc connections therewith, for increasing the strength of the field-magnet, and another circuit for primarily energizing the field-magnet, substantially as set forth.

4. The combination of a multiple-arc circuit from the main conductors for primarily energizing the field-magnet and the shunt-circuit from one of such main conductors around the multiple-arc connections therewith for increasing the strength of such field-magnet, substantially as set forth.

5. The combination of a multiple-arc circuit containing a portion of the coils of the field-magnet of a dynamo-electric machine, a multiple-arc circuit containing the armature of said machine, multiple-arc circuits containing lamps or other translating devices, (all these multiple-arc circuits being derived from the same main conductors,) and a shunt-circuit from one of said main conductors, including a portion of the coils of said field-magnet, the current in said shunt being dependent upon the number of translating devices in circuit, substantially as set forth.

This specification signed and witnessed this 10th day of February, 1882.

THOMAS A. EDISON.

Witnesses:
H. W. SEELY,
SAMUEL INSULL.

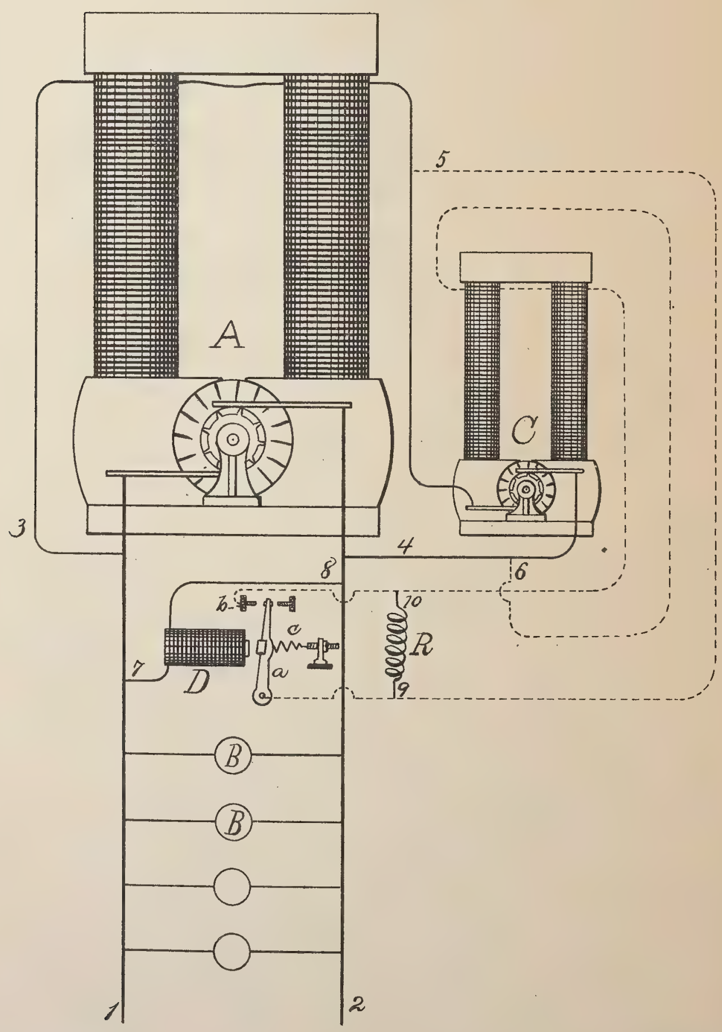
(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,672. Patented Sept. 19, 1882.

Fig. 1.



WITNESSES:
E. C. Rowland
H. W. Seely

INVENTOR:
T. A. Edison
BY Rich^d N. Dyer,
ATTORNEY.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,672. Patented Sept. 19, 1882.

Fig. 2.

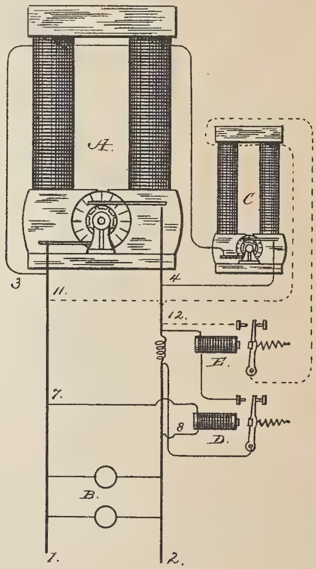
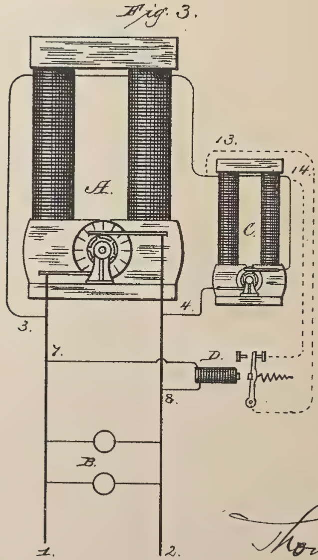


Fig. 3.



Witnesses;
J. H. Clark.
N. A. Clark

Inventor:
Thomas A. Edison
By Richd. N. Dyer,
Attorney.

N. PETERS, Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,672, dated September 19, 188:.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, Thomas A. Edison, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Regulating Electrical Generators, (Case No. 426;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce simple and efficient means for regulating the generative capacity of a dynamo or magneto electric machine by the counter electro-motive force of an electromotor located in its field-of-force circuit, and for governing or controlling the counter electro-motive force generated by such motor, so as to counteract variations in speed of engine, as well as number of lamps or other translating devices.

This invention is an improvement upon the special means described in my Patent No. 248,421. I accomplish the object sought by arranging the armature-coils of the motor directly in the field-circuit of the generator and the field-magnet coils of the motor in a circuit which is controlled by a vibrating circuit-controller operated directly or controlled by an electro-magnet arranged in a multiple-arc circuit from the main conductors of the generator. The field-circuit of the motor may be a shunt from the field-circuit of the generator around the armature-coils of the motor; or it may be a multiple-arc circuit from the main conductors of the generator; or the field-coils of the motor may be arranged in series with its armature-coils in the field-circuit, and the field-magnet of the motor be weakened and strengthened by closing and opening a shunt around the same. A shunt of high resistance is preferably formed around the vibrating circuit-controller, so that the motor will always have sufficient strength of field to run at a low speed. The armature of the operating or controlling electro-magnet in the multiple-arc circuit is provided with an adjustable retractor, so that the candle-power of the lamps can be adjusted.

The foregoing will be better understood from the drawings, in which Figure 1 is a view, partly diagrammatic, of an apparatus embodying the invention, and Figs. 2 and 3 similar views of modified connections.

A represents a dynamo or magneto electric machine, from which run main conductors 1 2, in multiple-arc circuits from which are located lamps or other translating devices, B. The field-circuit 3 4 of the generator is preferably a multiple-arc circuit from the main conductors 1 2. In this field-circuit are located the armature-coils of an electro-dynamic motor, C. The field-circuit 5 6 of the motor C is shown in Fig. 1 as a shunt from 3 4 around the armature-coils of the motor. This circuit 5 6 runs to the armature-lever *a* and its front contact, *b*. Said lever carries an armature attracted by an electro-magnet, D, located in a multiple-arc circuit, 7 8, from 1 2, and the lever is retracted by an adjustable spring, *c*. The magnet and lever form a vibrating circuit-controller, which, when closed, allows the field-magnet of the motor to strengthen, increasing the speed of the motor and its counter electro-motive force, and when open breaks the field-circuit of the motor, reducing its speed and counter electro-motive force. The motor is not, however, stopped entirely, since a shunt, 9 10, containing resistance R, is formed around the vibrating circuit-controller, and allows some current always to flow through the field of the motor. This resistance also reduces the spark at the points of the vibrating circuit-controller. It will be seen that the speed of the motor is increased by the strengthening of the magnet D and lessened by the weakening of such magnet, which is affected both by variations in speed and number of translating devices. If desired, the vibrating circuit-controller may break circuit at a number of points simultaneously in order to reduce the spark. This circuit-controller may be operated by the magnet D, arranged in multiple arc; or this magnet D may be used to open and close the circuit of another magnet, E, arranged in a shunt from one of the main conductors, Fig. 2, or from the field-circuit of the generator, which latter magnet will operate the vibrating circuit-controller.

As before explained, the field-circuit of the motor, instead of being a shunt from the field-circuit of the generator around the armature-coils of the motor, may be a multiple-arc circuit, 11 12, from 1 2, opened and closed by the electro-magnet D, or by an electro-magnet, E, in a local circuit controlled by D as a relay, Fig. 2; or the field-coils of the motor may be

arranged in series with its armature-coils and a shunt-circuit, 13 14, be formed around the field-magnet of the motor, Fig. 3, which shunt will be opened and closed by D or a magnet controlled by it, the operation, however, being the reverse of the other constructions.

What I claim is—

1. The combination, with a dynamo or magneto electric machine, of an electro-dynamic motor arranged in the field-circuit of such generator, and means in a separate multiple-arc circuit operated by the current for controlling the field-circuit of the motor, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine, of an electro-dynamic motor arranged in the field-circuit of the generator, and an electro-magnet located in a multiple-arc circuit from the main conductors of the generator, and arranged to control directly or indirectly the field-circuit of the motor, substantially as set forth.

3. The combination, with a dynamo or magneto electric machine, of an electro-dynamic motor arranged in the field-circuit of the generator, a vibrating electro-magnetic circuit-controller controlling the field-circuit of the motor, and a shunt of high resistance around such vibrating circuit-controller, substantially as set forth.

This specification signed and witnessed this 22d day of May, 1882.

THOMAS A. EDISON.

Witnesses:

EDW. C. ROWLAND,

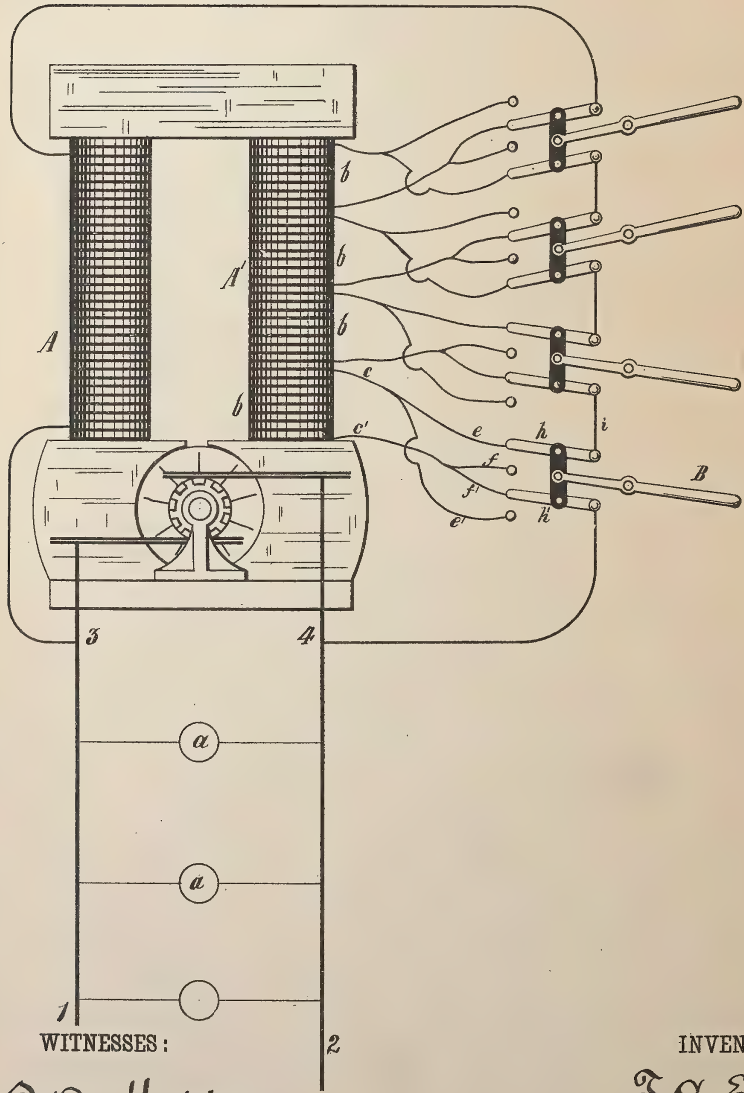
C. P. MOTT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 264,673. Patented Sept. 19, 1882.



WITNESSES:

O. D. Mott

J. Edw. Clark.

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 264,673, dated September 19, 1882.

Application filed November 28, 1881. Renewed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulating the Generative Capacity of Dynamo or Magneto Electric Machines, (Case No. 366;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

My invention consists in regulating the strength of the field-magnets of a dynamo or magneto electric machine and the current generated by such machine by reversing the current passing through more or less of the field-coils. This I do by winding the magnets in sections or bobbins, each section being provided with means for reversing the direction of its current. A convenient arrangement for this purpose is shown in the annexed drawing.

A A′ are the helices of the field-magnet of a dynamo-electric machine. 1 2 is the main circuit from such machine, having translating devices *a a* arranged in multiple arc upon them.

3 4 is the field-circuit by which the magnet A A′ is energized. The helix A′ is wound in separate sections *b b*, each end of the wire of each section extending out from the magnet. The arrangement of the lowest section, *b*, will illustrate that of the rest.

c c′ are the wire ends, each divided into two branches, *e e′* and *f f′*.

B is a circuit-reversing lever moving the pivoted arms *h h′*.

As shown in the drawing, the current is passing through all the coils of the helix in the same direction—viz., by wire 4, pivoted arm *h′*, wires *f′ c′ b c e*, pivoted arm *h*, by a wire, *i*, to the next circuit-reverser, and so on; but if it is desired to reduce the current generated by the machine the lever B is moved so as to bring *h* in contact with *f* and *h′* with *e′*. The direction of the current in the bottom section is thus changed, being now by arm *h′*, wires *e′ c b c′ f*, arm *h*, &c. The strength of the field-magnet is thus reduced. If a still further reduction is necessary, more of the sections *b* are reversed, as desired.

While only one of the helices is shown as wound in sections, it is evident that this may be done with both, and where the wire is wound upon the core in layers one above another one or more of the layers may be arranged to have their current reversed.

It is evident, also, that other forms of circuit-reversers may be used, and that they may be worked automatically without departing from the spirit of my invention.

This invention is of course equally applicable to dynamo or to magneto electric machines.

What I claim is—

1. The method of regulating the generative capacity of magneto or dynamo electric machines, consisting in reversing the polarity of the current in a greater or less portion of the coils of their field-magnets, substantially as set forth.

2. The combination, with a field-magnet of a dynamo or magneto electric machine, of means for reversing the polarity of the current in a greater or less portion of the coils of the magnet, substantially as set forth.

3. A dynamo or magneto electric machine having one or both of the limbs of its field-magnet wound in separate sections of wire, each section including a circuit-reverser, substantially as set forth.

This specification signed and witnessed this 3d day of November, 1881.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
RICHD. N. DYER.

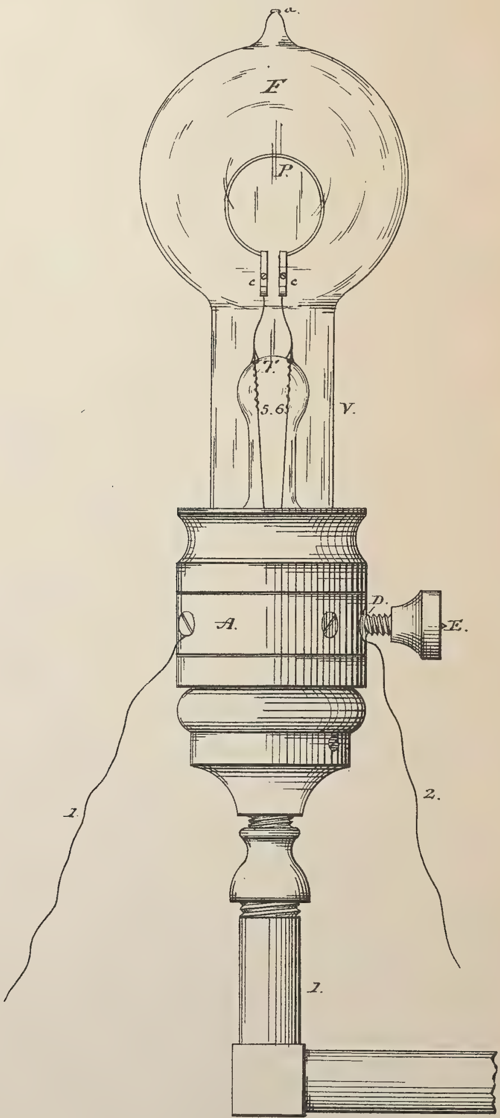
(Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

ELECTRIC LAMP AND HOLDER FOR THE SAME.

No. 265,311. Patented Oct. 3, 1882.

Fig. 1.



Attest

F. W. Howard

James A. Payne

Inventor:

T. A. Edison per

Dyer & Wilber

his Attys

N. PETERS, Photo-Lithographer, Washington, D. C.

(Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

ELECTRIC LAMP AND HOLDER FOR THE SAME.

No. 265,311. Patented Oct. 3, 1882.

Fig. 2.

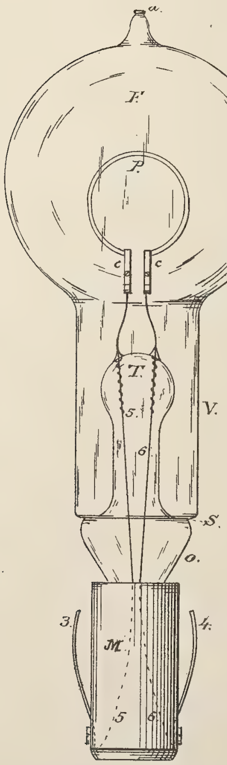


Fig. 3.

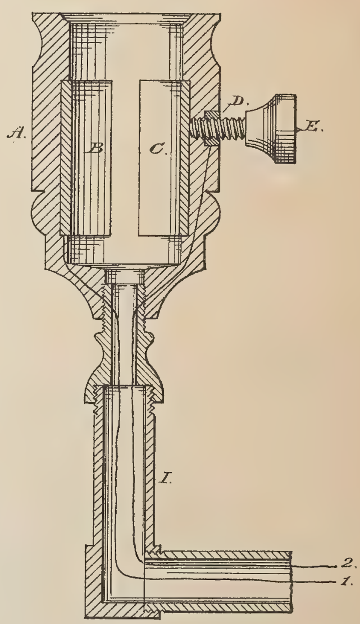
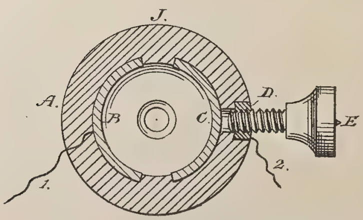


Fig. 4.



Attest:

F. W. Howard
James A. Payne

Inventor:

T. A. Edison
per Dyer & Wilber
his attys

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC LAMP AND HOLDER FOR THE SAME.

SPECIFICATION forming part of Letters Patent No. 265,311, dated October 3, 1882.

Application filed February 5, 1880. Renewed August 14, 1882. (Model.) Patented in England February 10, 1880, No. 578; in Italy April 28, 1880; in Belgium April 30, 1880, No. 51,155; in Victoria June 15, 1880, No. 2,842; in France June 16, 1880, No. 136,088; in India June 23, 1880, No. 415; in Sweden June 25, 1880; in Canada July 19, 1880, No. 11,520; in New South Wales July 26, 1880; in Queensland August 3, 1880; in Austria-Hungary August 13, 1880; in Portugal September 22, 1880, No. 621; in Norway September 24, 1880; in New Zealand October 18, 1880, No. 484; in Russia December 14, 1881; in Germany December 31, 1881, No. 15,602, and in Spain January 2, 1882.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, New Jersey, have invented a new and useful Electric Lamp and Holder for the Same, (Case No. 201,) of which the following is a specification.

In order to adopt a system of electric lighting for ordinary and domestic uses, it seems essential that a lamp should be devised complete in itself, so that it may be supplied as a separate article ready for attachment to a suitable support, and with conductors so arranged that when the lamp is placed in position the circuit-connections are completed without further adjustment, and the holder or socket for receiving the lamp should be arranged to subserve this purpose, this that there may be no difficulty encountered, no skilled care or attention needed in placing the lamps in position or in replacing one which from breakage or any cause whatever should become disabled.

The object of this invention is to attain this; and to that end it consists in an electric lamp as a separate article adapted to be readily placed upon or within or removed from a suitable holder, and in a socket or holder as a separate article adapted to receive and support upon or within it an electric lamp, and in the combination of these two separate articles and proper contacts for completing the electric circuit, and in other features more particularly hereinafter described and claimed.

Referring to the drawings hereto annexed, and forming part of this specification, Figure 1 is an elevation of my improved lamp and socket mounted on any suitable support. Fig. 2 is a view of the separate lamp. Fig. 3 is a longitudinal section of the socket, and Fig. 4 is a cross-section of Fig. 3 near the circuit-closing screw.

The lamp is composed of the glass globe F, formed with a neck, V, into which is slipped the glass portion O, having at its upper end the bulb T, which supports and into which are securely fastened the conductors 5 6, leading to P, which is some material capable of being rendered incandescent by an electric current. O and V are hermetically sealed by fusion at S, after which the globe F is exhausted of air, when it is sealed by fusion at *a*, thus making the lamp consist of a globe practically of one piece of glass hermetically inclosing in a vacuum a material, P, adapted to be rendered incandescent by an electric current. The extention V of globe F and the part O form a neck suitably elevating and supporting the globe. Thus far this lamp is more fully described in an application for a patent filed by me in the United States Patent Office on December 11, 1879.

Upon the lower end of the part O is secured a cylinder, M, of any suitable insulating material, provided on opposite sides with metallic springs or contact-pieces 3 4. From the clamps *c c*, which hold and support the incandescent arc P, the conductors 5 6 lead to the contact-pieces 3 4, adapted to complete the electrical circuit when the lamp is placed in position in the holder hereinafter to be described. This construction forms a separate electric lamp, which may readily be removed from or placed upon or within a suitable holder, the act of placing the lamps in position completing without adjustment or attention the necessary circuit-connections to the light-giving portion.

A is the socket or holder for receiving the lamp. It is made of suitable insulating material, shaped and ornamented as may be desired, receiving and supporting the neck of the electric lamp, and fashioned at one end so as to be fastened into a gas-fixture or other suitable support. As shown in the annexed drawings, it is a cylinder hollowed out from the top with a screw-threaded aperture in the base, by which it is attached to the bracket or chandelier arm I. Upon the interior are the metallic plates B C, insulated from each other. Upon the exterior, so that a line passing through it will strike one of the inner plates—in this case C—is the metallic nut D, insulated from C, in which works the metallic screw E. A conductor, 1, leads to the plate B, and a conduct-

or, 2, to the nut D. Upon turning the screw E electric connection between the plate C and nut D is either completed or broken, dependent upon the direction of the turning. The conductors 1 2 lead directly or indirectly from the source of electricity, and may be placed inside of gas or other suitable pipes or tubing, as shown in Fig. 3, or, as in Fig. 1, may be brought to the lamps in any convenient manner. From this it may be readily seen that if the lamp, Fig. 2, be placed in the socket H, Fig. 3, one spring, 3, bears against and forms electrical contact with one plate—say B—while the other spring, 4, bears against and forms electrical contact with the other plate, C. If screw E be turned so as to impinge firmly on plate C, a complete circuit is formed *via* wire 1, plate B, spring 3, wire 5, incandescent loop P, wire 6, spring 4, plate C, screw E, nut D, wire 2, the total lighting effect, a dim lighting effect, or no lighting effect being due respectively to a fine contact, a slight contact, or no contact between E and C.

From this description it is evident that the lamp is an article complete in itself, consisting substantially of an inclosing globe entirely of and sealed by glass, an incandescing material, and conductors therefrom to spring-contacts on an insulated base-piece, and without regulating or heat-absorbing devices, but capable of being placed in position for use without any attention or adjustment.

While I have shown contact-springs upon the exterior of the cylinder M on the neck of the lamp, and contact-plates upon the interior of the socket or holder, it is evident that this relation could be reversed—the plates being placed on the neck of the lamps and the springs in the socket—without departing from the spirit of my invention or requiring any further invention. It is also evident that the lamp could be so constructed that its neck would embrace the holder, instead of being placed therein.

What I claim is—

1. A separate electric lamp, consisting essentially of an inclosing globe entirely of glass, an incandescing material secured therein, conductors leading thereto and sealed in the glass where they pass therethrough, and a base of insulating material in which the neck of the globe is secured, said base being provided with metallic contact-plates to which the conductors leading into the globe are secured at their outer ends.

2. A socket for an electric lamp, adapted to be placed upon a gas-pipe or other suitable support, and provided with contact-plates forming the terminals of an electric circuit, and arranged substantially as set forth.

3. A socket for an electric lamp, adapted to be placed upon a gas-pipe or other suitable support, and provided with contact-plates forming the terminals of an electric circuit, and also provided with a circuit-controller inserted in one branch of the circuit for controlling the circuit, substantially as set forth.

4. The combination of a separate electric lamp made and provided with a base, as described, and a socket adapted to be secured upon a gas-pipe or other suitable support, and provided with contact-plates, as set forth, so that the two may be readily attached or detached, substantially as set forth.

5. The combination, with a bracket or chandelier arm or other gas or hollow pipe containing the wires of an electric circuit, of a socket or holder for an electric lamp adapted to be secured therein and to receive and support the lamp, and provided with contact-plates forming the terminals of the wires of the electrical circuit, substantially as set forth.

6. The combination of an electric lamp having an insulated base provided with contact-plates thereon, and a socket or holder for receiving and supporting the lamp, provided with contact-plates forming electrical connection with and completing the circuit through the plates on the base of the lamp, substantially as set forth.

In testimony whereof I have hereunto affixed my signature this 28th day of January, A. D. 1880.

THOS. A. EDISON.

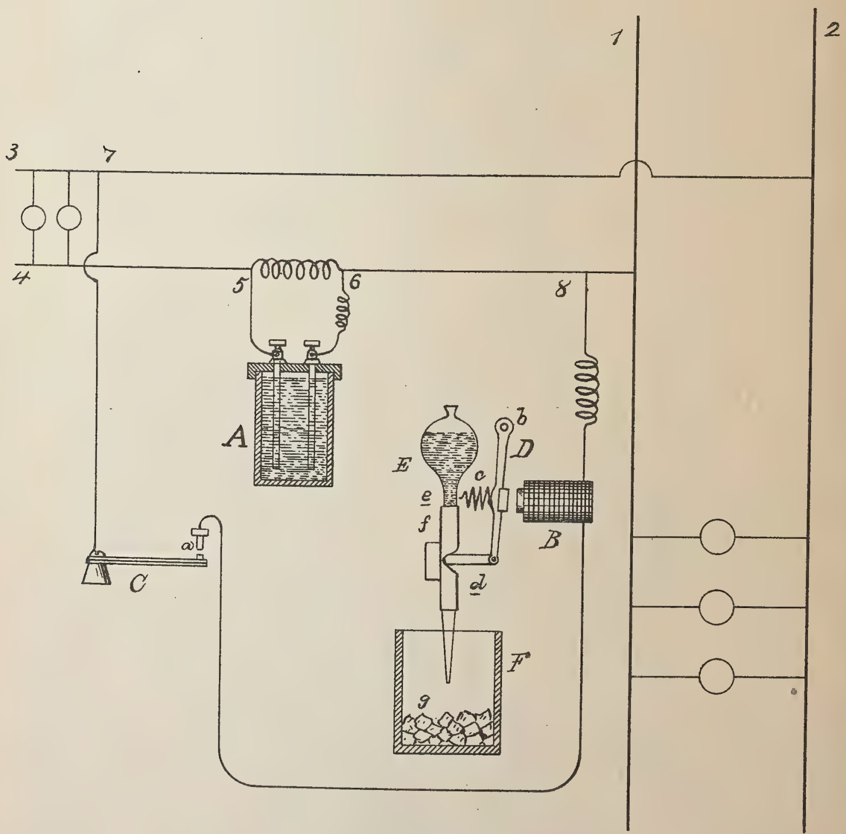
Witnesses:
C. P. MOTT,
SAM. D. MOTT.

(No Model.)

T. A. EDISON.

METHOD OF MAINTAINING TEMPERATURE IN WEBERMETERS.

No. 265,774. Patented Oct. 10, 1882.



WITNESSES:

E. C. Rowland,
J. F. Clark.

INVENTOR:

Thomas A. Edison,
By Richd. N. Dyer
Atty.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

METHOD OF MAINTAINING TEMPERATURE IN WEBERMETERS.

SPECIFICATION forming part of Letters Patent No. 265,774, dated October 10, 1882.

Application filed November 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Webermeters, (Case No. 350;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

An electrolytic webermeter used in connection with a group or house system of lamps or translating devices to measure the amount of energy supplied thereto from a central station must sometimes be placed in a position where it will be exposed to fluctuations of temperature and incur danger of the freezing of the liquid. During the continuance of such freezing, if it should happen, the webermeter would of course fail to perform its duty.

The object of this invention therefore is to provide a method which will insure a maintenance of temperature above the freezing-point within the webermeter box or case.

The method may be stated generally as consisting in causing a dangerous fall of temperature to set in action agencies which then act upon means arranged and adapted to heat to the necessary degree the atmosphere within the webermeter box or case, or around and in immediate contiguity to the webermeter. Suitable means for carrying this into practice may be briefly described as follows: Within the webermeter box or case a thermostatic spring is arranged, with its free end controlling directly or through intermediate mechanism the vent of a small water-reservoir, and in such manner that at ordinary or non-dangerous temperatures the vent is entirely closed, but so that when the temperature falls to near the freezing-point the vent shall be opened and permit the water to escape in a small stream or drop by drop. Below the vent, and so that the water issuing therefrom shall fall therein, is a receptacle holding a quantity of acetate of soda or of quicklime. The vent being opened and water falling thereon, heat is generated, which raises the temperature within the box and prevents the freezing of the liquid.

It is evident that the thermostat, instead of acting directly or through intermediate mechanical means, may operate to close a circuit, which may be derived from the main circuit through a magnet controlling the vent, or that it may act as the stop to a clock-work, which, released, shall pump water upon the material used, or which may control the vent.

A convenient mode of carrying my invention into effect is illustrated diagrammatically in the annexed drawing.

3 4 is the house-circuit whose current is to be measured, which is derived from the main line 1 2. In a shunt, 5 6, from the circuit 3 4 is the electrolytic-cell meter A.

7 8 is a multiple-arc circuit from the circuit 3 4, including the coils of an electro-magnet, B, and also including the compound thermostatic bar C, whose free end is normally held away from contact at *a*, thus keeping open the circuit 7 8; but on a considerable decrease of temperature, sufficient to cause danger of the freezing of the liquid in the cell A, the unequal contraction of the two metals which compose the bar C causes a movement of such bar and closes the circuit. The magnet B, being thus energized, draws toward its poles the armature-lever D, which is pivoted at *b*, and has a retracting-spring, *c*. To the lever D is attached an arm, *d*.

E is a vessel containing water, its lower end formed into a tube, *e*, which enters a rubber tube, *f*. The lower end of tube *f* is placed over a vessel, F, containing pieces of quicklime *g*. When the circuit 7 8 is open and the magnet B not energized the arm *d* presses against the rubber tube *f*, so as to close it and prevent the water from escaping; but when the magnet is energized the arm *d* is withdrawn and the water is allowed to drop into the vessel F onto the lime, and the heat thus evolved warms the liquid in the meter, which is in close proximity thereto, and prevents the freezing thereof.

It is also evident that the thermostatic spring may act to close an electrical circuit through a resistance adapted to be heated thereby, and placed in proximity to the webermeter cell or cells, or to close a circuit to an electric lamp placed in the same position for heating the temperature.

Separate application for patent has been made for some of these specific means of carrying the method into effect, and for the others such separate applications will be hereafter made; hence they are not claimed herein; but

What I do claim herein is—

The herein-described method of maintaining the temperature of the liquid in an electrolytic cell above the freezing-point, which consists in causing a fall in temperature to set in action agencies for generating heat, substantially as set forth.

This specification signed and witnessed this 21st day of September, 1881.

THOMAS A. EDISON.

Witnesses:

H. W. SEELY,

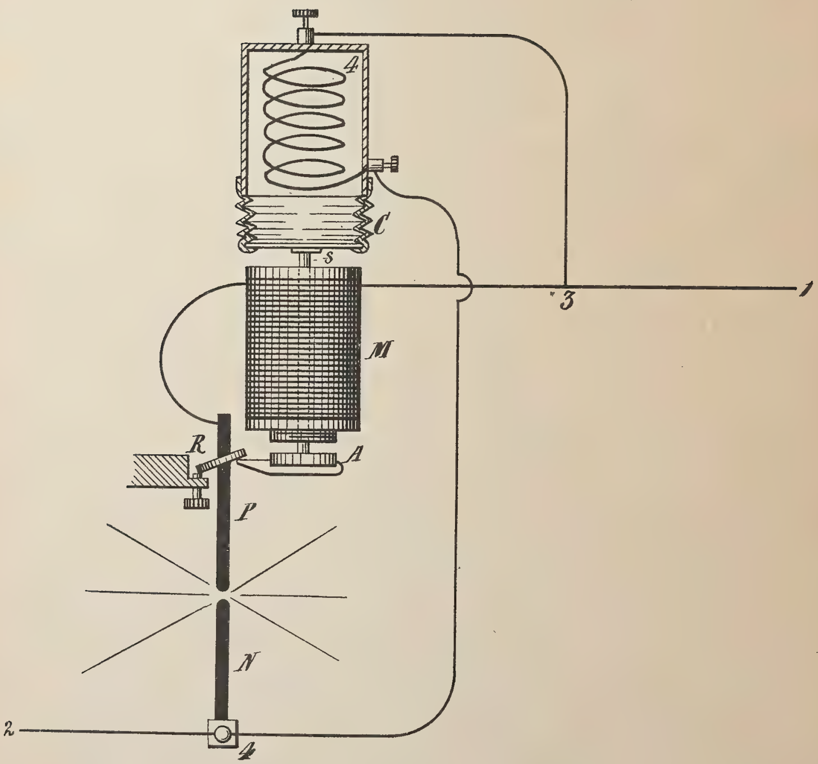
RICHD. N. DYER.

(No Model.)

T. A. EDISON.

ELECTRIC ARC LIGHT.

No. 265,775. Patented Oct. 10, 1882.



WITNESSES:

O. D. Mott
Thomas E. Birch

INVENTOR:

T. A. Edison
BY Dyer & Wilber
ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC-ARC LIGHT.

SPECIFICATION forming part of Letters Patent No. 265,775, dated October 10, 1882.

Application filed November 28, 1881. Renewed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the County of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric-Arc Lights, (Case No. 371;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of my invention is to produce novel and effective means for regulating the feed of the carbons of voltaic-arc lamps.

In carrying out my invention I place in the main circuit, including the arc, an electro-magnet or a solenoid holding up an armature which holds up the upper carbon; and in a shunt around the magnet and carbons I place a heating-coil whose action raises and lowers the armature, opposing that of the magnet. As the length of the arc increases the resistance of the main line becomes greater and more current passes through the shunt, heating the coil therein and forcing the armature away from the magnet, so as to lower the carbon connected with the armature. The resistance is thus diminished, less current passes through the shunt, and the armature is drawn up and held by the magnet.

Convenient means for carrying my invention into effect are shown in the drawing.

1 2 is the main circuit, including the carbons P N and the electro-magnet M.

3 4 is a shunt around the carbons and magnet, including the heating-coil H.

C is an expansible chamber, the air in which is heated by the coil H, and expands and contracts as the coil is more or less heated. The chamber C is connected by a rod, S, with the armature A, so that such armature is raised and lowered by the alternate contraction and expansion of the chamber. The rod S might be the movable core of a solenoid, R, representing any suitable device operated by the movement of the armature A for regulating the feed of the carbon P.

It is evident that while the use of the expansible chamber produces an increased effect it might be dispensed with and the expansion and contraction of the coil H utilized directly.

What I claim is—

1. In an electric-arc lamp, the combination of the main circuit, containing the carbons and an electro-magnet or solenoid, with a shunt around the arc, containing a heating-coil adapted to oppose by its action the action of the magnet, substantially as set forth.

2. In an electric-arc lamp, the combination of the main circuit containing the carbons and an electro-magnet or solenoid, a shunt around the arc, containing a heating-coil, and an expansible chamber, substantially as and for the purpose set forth.

3. In regulating mechanism for electric-arc lights, the electric heating-coil and expansible inclosing chamber, substantially as and for the purpose set forth.

This specification signed and witnessed this 7th day of November, 1881.

THOS. A. EDISON.

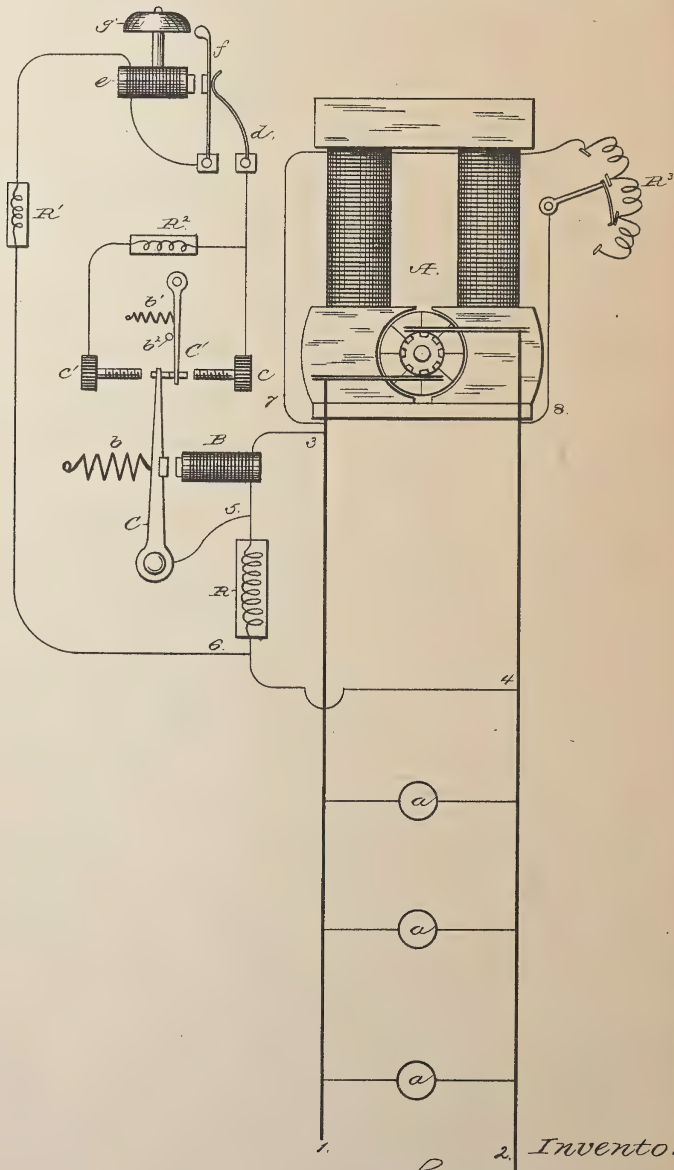
Witnesses:
H. W. SEELY,
RICHD. N. DYER.

(No Model.)

T. A. EDISON.

ELECTRIC LIGHTING SYSTEM.

No. 265,776. Patented Oct. 10, 1882.



Witnesses;
J. C. Clark.
N. A. Clark.

Inventor;
Thomas A. Edison
By Richd. N. Dyer,
Attorney.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC-LIGHTING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 265,776, dated October 10, 1882.

Application filed November 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric-Lighting Systems, (Case No. 354;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object I have in view is to produce devices to be used in connection with dynamo or magneto electric machines and electric lights, which will notify the engineer when the lights are above or below the desired limit of candle-power, so that he can regulate the generative capacity of the machine or machines in accordance therewith. These devices are especially adapted for use in "isolated work," or with plants for lighting separate buildings or small areas, and in connection with incandescing electric lamps arranged in multiple arc. This object I accomplish by arranging an electro-magnet in a derived or multiple-arc circuit from the main or consumption circuit, such magnet-circuit having many times more resistance than one of the lamp-circuits, a wire or other resistance being placed therein for that purpose. An incandescing lamp may, however, be used for this resistance. In a shunt-circuit around this resistance are arranged the armature-lever of the magnet and a vibrating bell. The free end of the armature-lever plays between two contacts the making of each of which completes a circuit through the bell-hammer vibrator. Between the armature-lever and the front contact is a yielding stop, which may be an arm held back against a fixed pin by a spring. This yielding stop-arm determines the central position of the armature-lever. One of these bell-circuits has considerably more resistance than the other, so that alarms varying noticeably in their loudness will be produced. When the lamps are within the fixed limits of candle-power the magnet will attract the lever sufficiently against the retractile force of its spring to separate it from the back contact, and will hold it forward against the spring stop-arm, so as to open the bell-circuit. Now, if the current increases so as to raise the lamps above the limit of candle-power, the armature-lever will be attracted by the magnet and will overcome the spring stop-arm and force the same against the front contact, completing the bell-circuit through a definite resistance, and causing a loud alarm to be sounded, which will continue until the engineer regulates the generator or generators so as to reduce the candle-power of the lights. If the lights drop below the limit of candle-power, the magnet will at the same time be weakened and the lever will make the back contact. This completes the bell-circuit through greater resistance than when the front contact is made, and a continuous alarm will be sounded, which will be noticeably feebler than in the instance first described. As soon as the lights are brought up to the desired degree of luminosity the alarm will cease to sound, the bell-circuit being broken by the attraction of the lever to a central position against the spring.

It is evident that, instead of using a single vibrating bell with two circuits having different resistance, two bells might be used, in which case the bell-circuits might have different resistances, or the circuits could have the same resistance and the bells be constructed to give sounds of different pitch, or both features could be combined.

Instead of bell-alarms alone, an indicator might be used consisting of a pointer traveling upon a scale to right or left, and operated by the armature-lever of the electro-magnet in the multiple-arc circuit, and in connection with the indicator an alarm could be arranged to strike when the pointer reached a certain point on either side of its normal position.

The foregoing will be better understood by reference to the drawing, in which the figure is a diagrammatic view.

A represents a dynamo or magneto electric machine; 1 2, the main or consumption circuit, and *a a* incandescing lamps in multiple-arc or derived circuits.

3 4 represent a multiple-arc or derived circuit from 1 2, having resistance R and the coils of an electro-magnet, B, placed therein. From 3 4 is a shunt, 5 6, around the resistance R. The armature-lever C, retracted by spring *b*, is in this circuit. Front and back contacts,

c c', are connected with the spring *d* of the vibrating-bell mechanism, which consists of electro-magnet *e*, armature-lever *f*, forming bell-hammer, and gong *g*. Resistances R' R^2 are arranged in the bell-circuit, resistance R' being in the circuit of each contact *c c'*, while R^2 is only in the circuit of the back contact, *c'*. A yielding stop-arm, C', is placed between lever C and front contact, *c*, and is drawn back by a spring, *b'*, against a fixed pin, b^2.

The field-of-force circuit of the machine A may be a multiple-arc circuit, 7 8, from 1 2, and be provided with an adjustable resistance, R^3, for regulating the generative capacity, as required by the sounding of the alarm.

The alarm described is useful with other translating devices besides lamps to show corresponding conditions.

What I claim is—

1. The combination, with one or more electrical generators, means for regulating such generator or generators, and electric lamps arranged in multiple arc, of an electrically-operated alarm or indicator for indicating predetermined limits above or below or both above and below the desired or normal condition of the current, and an electro-magnet located in a multiple-arc circuit and controlling the circuits of such alarm or indicator, substantially as set forth.

2. The combination, with one or more electrical generators, means for regulating such generator or generators, and electric lamps arranged in multiple arc, of an electrically-operated alarm or indicator for indicating predetermined limits above or below or both above and below the desired or normal condition of the current, an electro-magnet located in a multiple-arc circuit, the armature-lever of such magnet, making and breaking the circuits of such alarm or indicator at its contacts, and means for determining the central position of such armature-lever, substantially as set forth.

3. The combination of a main circuit, an electro-magnet in a derived circuit, and an armature-lever therefor, completing circuits at both its front and back contacts, resistances differing in amount, located in said circuits, and a vibrating magnetic alarm, substantially as set forth.

This specification signed and witnessed this 27th day of September, 1881.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

RICHD. N. DYER.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

METHOD OF TREATING CARBONS FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 265,777, dated October 10, 1882.

Application filed December 15, 1880. (No model.) Patented in England February 9, 1881, No. 562; in Italy May 19, 1881; in Belgium May 31, 1881, No. 54,587; in Victoria June 15, 1881, No. 3,024; in Canada July 5, 1881, No. 13,057; in France July 20, 1881, No. 142,723; in Austria-Hungary August 3, 1881; in New South Wales August 13, 1881; in Queensland August 23, 1881; in Spain September 5, 1881; in New Zealand September 15, 1881, No. 549, and in Portugal December 14, 1881, No. 715.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Method of Treating Carbons for Electric Lamps, (Case No. 275;) and I do hereby declare that the following is a full and exact description of the same.

In the manufacture of my incandescing electric lamps, having for the continuous incandescing conductor a flexible carbon filament of high resistance, I have found that there is a considerable quantity of air, gas, and aqueous vapor occluded in the carbon filament and the clamps, which are not removed from the lamp by the action of the pump, but have to be driven off by raising the carbon filament to incandescence by the passage of an electric current therethrough.

In Patent No. 227,229, granted to me May 4, 1880, the method is described of driving the air from a metallic incandescing conductor by the heat of the conductor when raised to incandescence by the passage of an electric current therethrough. In applying this method to a carbon filament, however, some changes have to be made, occasioned by the increased quantity of air, gas, and aqueous vapor occluded by the carbon filament, and also by the fact that the air has to be driven from the enlarged ends of the filament and from the metal clamps wholly by conduction of heat from the incandescent body of the filament. These changes in the method consist principally in maintaining the incandescence of the carbon filament for a longer period than with a metallic incandescing conductor, and in raising the carbon filament gradually to a higher degree of incandescence than with the metallic conductor. With the carbon filament the incandescence finally produced in the process of exhaustion is always higher than the degree of incandescence to which the filament will be raised in use. With the carbon filament (in this respect differing from the metallic conductor) it is desirable that greater flexibility should be given the filament than it would have if the lamp were exhausted simply by the action of the pump, so that the carbon filament can withstand, without fracture, the jars to which it will be subjected in handling and transportation previous to the use of the lamp. This additional flexibility is given the carbon filament by the passage of an electric current therethrough, the operation being simultaneous with that of driving out the occluded air, gas, and aqueous vapor. It is also desirable to fix the shape of the carbon filament during the manufacture of the lamp, so that the character of the lamp can be determined, since some of the filaments are warped or bent more or less to one side or the other when raised to incandescence; but by raising the carbon filament to higher incandescence than that to which it will be raised in use the shape of the filament will be fixed and determined, and will not be changed by the future use of the lamp. This operation, which is peculiar to the carbon-filament operation, is also simultaneous with that of driving out the occluded air, gas, and aqueous vapor.

In carrying out the invention the parts of the lamp are assembled and united as described in my application No. 22,301, of even date with this application, or in any other suitable manner. The lamp is then attached to the exhausting apparatus, (a Sprengel drop-pump,) and when the proper high degree of exhaustion has been obtained an electric current is passed through the lamp, and by cutting resistance out of circuit the filament is gradually raised in incandescence. The filament is kept for some time at a medium incandescence, the operation of the exhausting apparatus being meanwhile continued. The filament is then raised to a much higher incandescence by the cutting out of more resistance, until the air and gas and aqueous vapor have been driven from the enlarged ends of the filament and the clamps, which can be readily determined by the disappearance of a blue or violet color which is seen at the clamps while the gas and vapor are being driven off. This high incandescence is considerably higher than that at which the

lamp is designed to be used, it being from thirty candle-power upward in a lamp designed to give sixteen candle-power.

What I claim is—

1. The method of treating the carbon filament of an incandescing electric lamp, consisting in raising such carbon filament to incandescence during the latter part of the process of exhausting the lamp-globe, whereby the air and gas are driven from the carbon filament and the flexibility of the filament is increased, substantially as set forth.

2. The method of treating the carbon filament of an incandescing electric lamp, consisting in raising such carbon filament to a higher incandescence than that at which it is designed to be used during the latter part of the process of exhausting the lamp-globe, whereby the air and gas are driven from the carbon filament and from its enlarged ends and clamps, and the flexibility of such filament is increased and its shape fixed, substantially as set forth.

This specification signed and witnessed this 11th day of December, 1880.

THOS. A. EDISON.

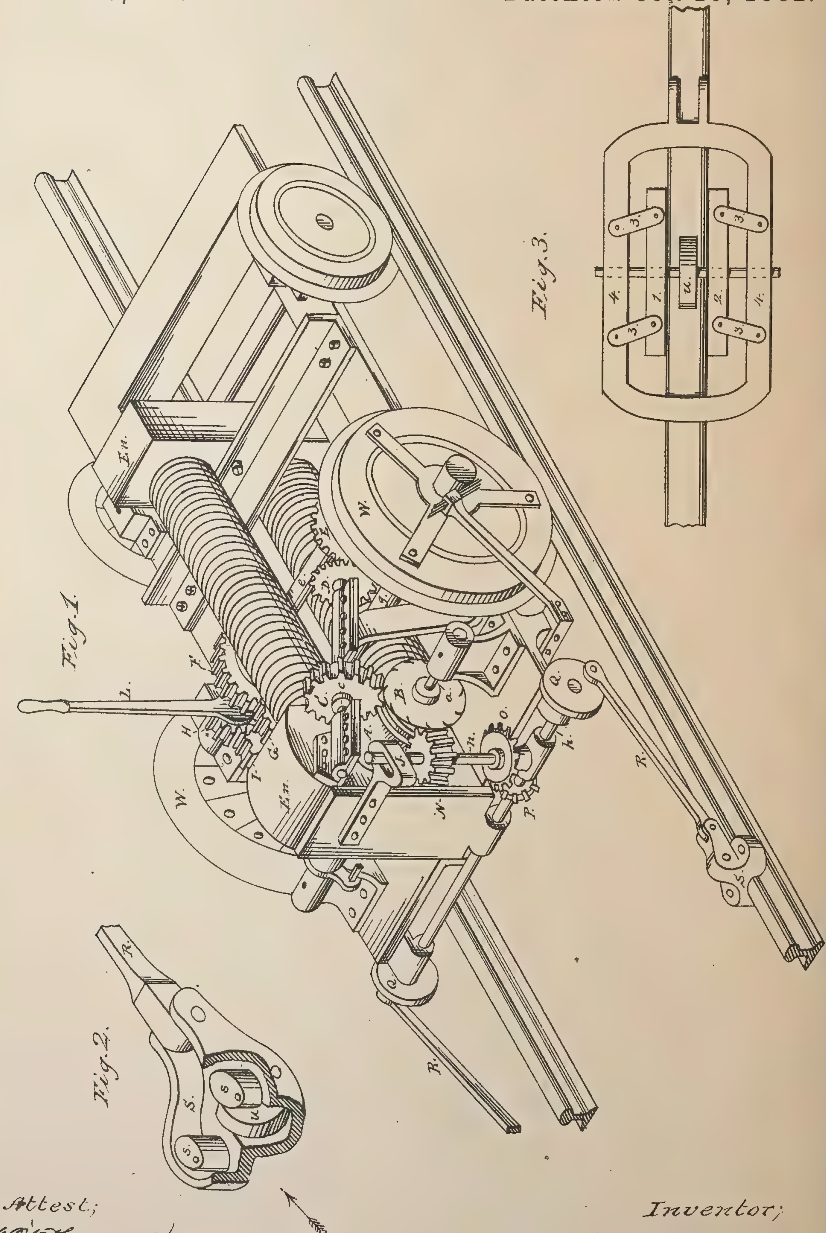
Witnesses:
H. W. SEELY,
WM. CARMAN.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

ELECTRO MAGNETIC RAILWAY ENGINE.

No. 265,778. Patented Oct. 10, 1882.



Attest;

F. W. Howard

James A. Payne

Inventor;

T. A. Edison

per Dyer and Wilber

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

ELECTRO MAGNETIC RAILWAY ENGINE.

No. 265,778. Patented Oct. 10, 1882.

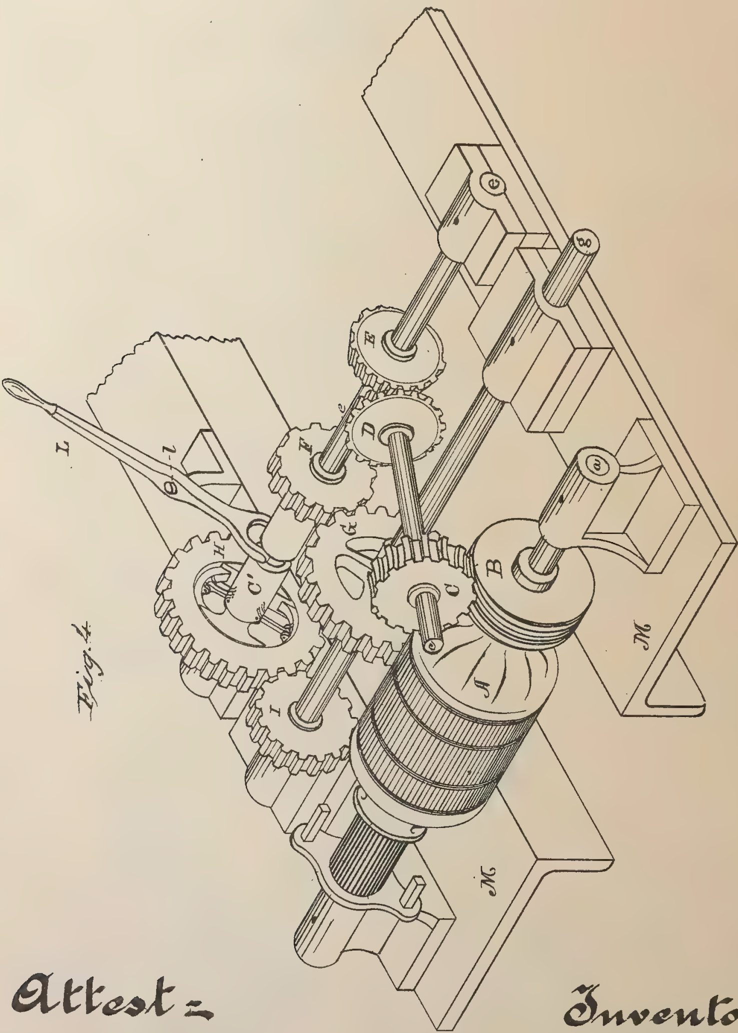


Fig. 4.

Attest:
S. D. Mott
James A. Payne

Inventor:
Thos. A. Edison
per Dyer and Wilber
Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRO-MAGNETIC RAILWAY-ENGINE.

SPECIFICATION forming part of Letters Patent No. 265,778, dated October 10, 1882.

Application filed July 22, 1880. (No model.) Patented in England September 25, 1880, No. 3,894; in Canada March 31, 1881, No. 12,568; in India May 3, 1881, No. 341; in Victoria May 12, 1881, No. 3,012; in France May 27, 1881, No. 141,752; in New South Wales June 25, 1881; in Queensland June 30, 1881, and in New Zealand August 2, 1881, No. 542.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have made certain new and useful inventions in Electro-Magnetic Railway-Engines, (Case No. 223;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The invention relates to that class of devices for the propulsion of vehicles known as "travelers" or "creepers," which, reciprocated upon a rail, slide freely in one direction, but are locked to the rail upon attempted movement in the other direction.

The object is to furnish a device of this general type simple in construction, certain in operation, and arranged so that it may be thrown into or out of operation and into or out of operative position at will, and adapted to be used with the ordinary rails of an ordinary railroad-track; to which ends it consists in the features more particularly hereinafter described and claimed.

Upon a suitable frame-work supported on running-gear is mounted an electro-magnetic engine, whose rotating shaft is connected through intermediate mechanism to the driving-wheels, all as shown in my application for a patent filed June 3, 1880, and bearing serial number 11,243. Upon the rotating shaft of the engine is fixed a thread, with which gears a worm carried on a vertical shaft. This vertical shaft is mounted in adjustable bearings, so that the worm may be thrown into or out of gear with the thread, as desired. Upon the lower end of the vertical shaft is a bevel-gear meshing into a bevel-gear upon a horizontal shaft, to whose ends, by crank arms or pins, are attached rods, each carrying at its opposite end a box or casing provided with a central wheel which rides upon the rail. In the box or casing, so as to take upon the sides of the rail, are eccentrically pivoted two wheels, one on each side. These side wheels, being eccentrically pivoted, allow the box to be pushed forward along the side of the rail, but prevent retrograde motion by closing together and grasping the rail.

The arms carrying the grippers or creepers are mounted so that they may be let down upon or removed from the track, as occasion requires. Hence, as a rod is reciprocated from the motor through the gearing described it pushes forward during one half-revolution the box or casing which slides upon the rail. Upon the commencement of the other half of the revolution, by the action of the eccentrically-pivoted wheels or rollers, the box or casing is locked to the rail and the engine is pulled up. One only being used, the action would be a series of pulls and pauses; and, if desired, one only may be used, taken upon either rail or upon a central rail laid especially for this purpose. In practice, however, it is desirable to use at least two—one for each rail—with cranks so arranged relatively to each other that while one is being slid forward the other is holding, so that a continuous motion may be produced. Additional grippers or creepers may also be placed at the rear of the train, so that a continuous pulling and pushing action is produced. Instead of rollers within the box or casing referred to, another form of device may be used in order to give a larger gripping-surface. Within the box or casing are two bars parallel to the rail, one on each side. These bars are attached to the casing or box by loose toggle-joints in such way that upon motion forward of the box or casing the bars recede from the rail, but upon retrograde movement they approach and grip the rail.

The operation of these devices will be better understood by reference to the drawings, in which—

Figure 1 is a perspective view of an engine embodying a motor and a creeper or traveler. Figs. 2 and 3 are details of the creeper. Fig. 4 is a perspective view of the motor-gearing.

A is the rotating armature of the electric motor, mounted on shaft *a*, secured in suitable bearings. Upon the shaft *a* is a worm or screw, B, gearing into C on inclined shaft *c*, upon whose lower end is the bevel-gear D, by means of which and the other intermediate mechanism shown motion is communicated from A to the driving-wheels of the engine. Upon the front end of the engine-car is a shaft, *h*, on which is a sleeve supporting the lower end of a shaft, *n*,

whose upper end is secured in a bearing, J, which permits of a slight movement of the shaft n. Upon n is mounted a worm-gear, N, which may be made to mesh with the worm or screw B on the armature-shaft a. Upon and near the lower end of n is the bevel-gear O, meshing into a bevel-gear, P, upon shaft h, to whose outer ends are attached the arms R by means of cranks Q. The arms R are attached to the crank-shaft at diametrically-opposite points, so that they will move in opposite directions and impart a continuous motion to the car. These arms R are arranged with any simple lifting device, so that they can be let down upon or removed up from the rails.

Pivoted to R is a box or casing, S, in whose upper portion is a wheel, u, riding upon the top of the rail. Within S, and upon each side of the rail, wheels s are mounted eccentrically, pivoted as shown, the opening between them at the widest being just enough more than the width of the rail to permit its passage therethrough. From this it is evident that if a body the width of a rail be slid between them in the direction of the arrow, Fig. 2, it will push them apart; but that if the motion be in the opposite direction it will cause the rollers s s to approach each other, gripping the body between them.

When necessary, the worm N is thrown into gear with B, motion being communicated thereby to the arms R. Upon the forward half of the movement the arm R pushes the box S along the rail. Upon the commencement of the latter half of the movement the rollers s s approach each other, gripping the track and locking the box or casing to it, whereupon the car is pulled up toward S.

Where the rails are light and might possibly be injured or indented, an alternative device (shown in Fig. 3) may be used, which gives a long grip upon each side of the rail-head. In this figure, 4 is a box or frame connected pivotally to R, and having the wheel u, as in the other form. Connected to 4 by toggle-joints 3 3 are the gripping-bars 1 2, one on each side. As seen, upon motion of the box or frame in direction of the arrow, on account of the toggles used, the bars 1 2 recede from the rail, but upon motion in the opposite direction approach the rail, gripping it and locking the box or frame thereto.

Springs may be applied to the rollers s s or bars 1 2, so as to normally hold them to the rail with a light pressure, not sufficient to interfere with their sliding in one direction, but causing them to act instantly upon attempted motion in the opposite direction.

In the use of either construction shown it is evident that while in position upon the rails they may be caused to operate or be thrown out of operation by moving the shaft n in its upper bearing, the sleeve on h, forming its lower bearing, permitting such movement, while, when desired, the arms may be lifted up and secured in position away from the rails.

What I claim is—

1. The gripping mechanism for electro-magnetic engines, consisting of an open-bottomed box or casing and eccentric rollers or cam-plates pivoted to or secured within the box or casing upon opposite sides thereof, and adapted to approach each other upon movement of the box in one direction longitudinally and to recede from each other upon movement of the box in an opposite direction, substantially as set forth.

2. The combination, with an electro-magnetic railway-engine, of a crank-shaft revolved by connection with the motor, two reciprocating arms attached to such shaft at opposite points, so as to work oppositely, and grippers carried by such reciprocating arms and acting upon the rails of the road, substantially as set forth.

3. The combination, with the electric motor of an electric railway-engine, of an arm or arms reciprocated thereby through suitable intervening mechanism, and each carrying a creeper or traveler, as described, and means for connecting or disconnecting at will the arm or arms and the motor from each other, substantially as set forth.

This specification signed and witnessed this 3d day of July, 1880.

THOS. A. EDISON.

Witnesses:

FRANK MCLAUGHLIN,
SAMUEL EDISON.

(No Model.)

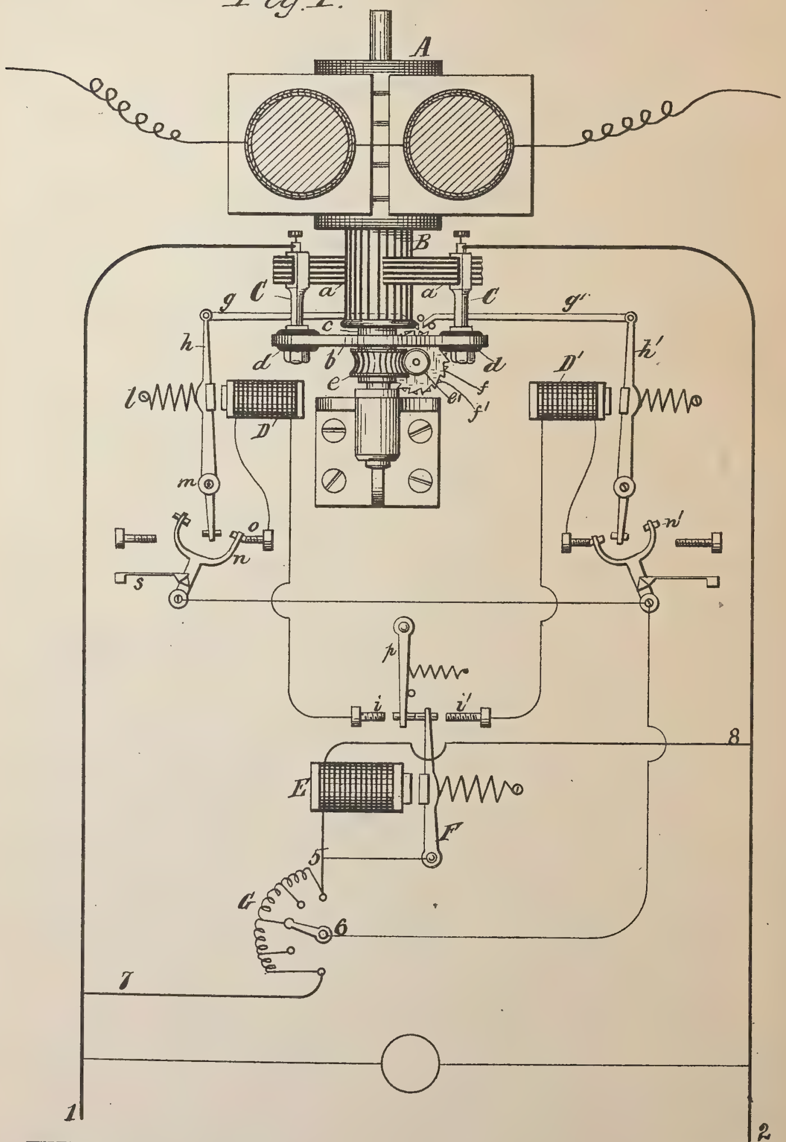
2 Sheets—Sheet 1.

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 265,779. Patented Oct. 10, 1882.

Fig. 1.



WITNESSES:

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Thomas E. Birch.

INVENTOR:

T. A. Edison

BY Richd. N. Dyer

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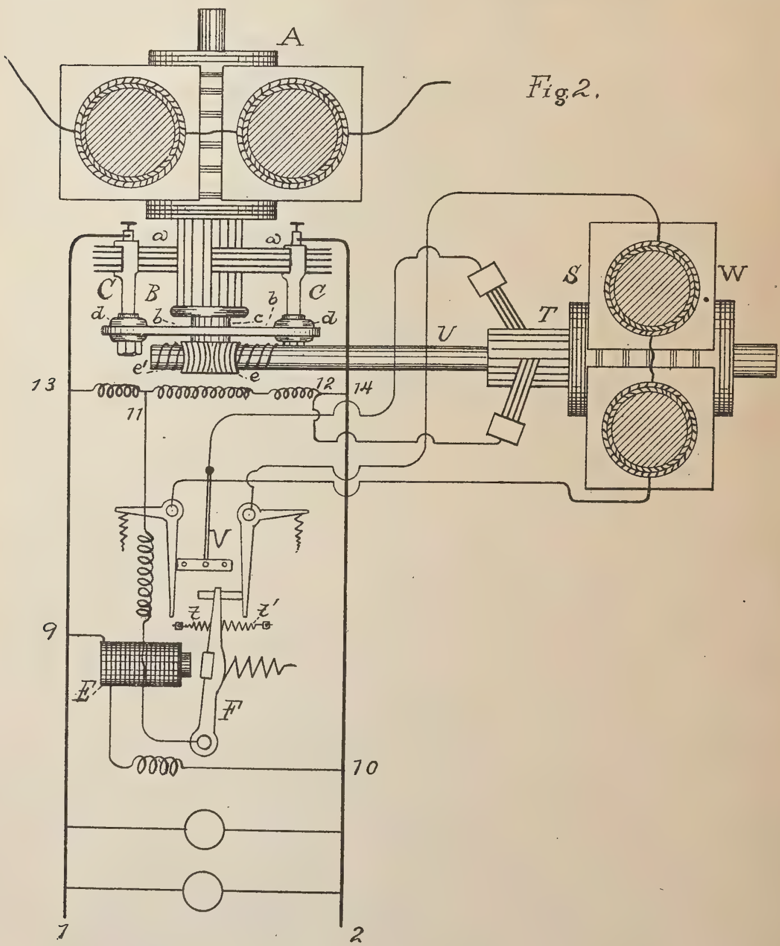
N PETERS. Photo-Lithographer. Washington. D. C.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 265,779. Patented Oct. 10, 1882.



WITNESSES:
Geo. C. Rowland
M. J. Clagett

INVENTOR:
Thomas A. Edison

BY Rich^d. N. Dyer
ATTORNEY

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 265,779, dated October 10, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Regulating the Generative Capacity of Dynamo or Magneto Electric Machines, (Case No. 391;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of my invention is to produce mechanism for automatically shifting the position (relative to the neutral line) of the commutator-brushes upon the commutator-cylinder of a magneto or dynamo electric machine, supplying current to a multiple-arc system of distribution, so as to vary the current generated in such machine, such mechanism being operated entirely and continuously by the variations of resistance in the external circuit of the machine which contains the lamps or other translating devices. Such mechanism also is to have a continuous operation—that is to say, one not dependent upon and limited by the play of an armature-lever, but accomplished by a continuous revolution, and not by a single impulse. By this means any extent of movement may be given to the brushes, while in devices of this kind heretofore in use the brushes can be moved only a short distance in either direction—that is, only as far as the pivoted armature of an electro-magnet can move. In accomplishing this object I place in a multiple-arc or derived circuit from the main circuit of the dynamo or magneto electric generator an electro-magnet provided with a pivoted armature-lever, which lever forms a part of a shunt-circuit from the multiple-arc circuit and has its free end placed between contact-points. A pivoted spring-arm is also placed between these contact-points in such manner that the forward movement of the armature forces it against one of them and completes a branch or division of the shunt-circuit, while the armature, when drawn back a sufficient distance, strikes the other contact-point and completes the other division. Normally, however, the armature and spring-arm are held by the resilience of their springs and by a properly-placed stop midway between the contact-points, and either division of the circuit is completed only by an increase or decrease in the force of the electro-magnet. This spring-arm serves to determine the central position of the armature-lever, so that such lever will not be affected by slight magnetic changes. Each of these divisions of the shunt-circuit contains an electro-magnet provided with a vibrating armature and a circuit-reverser operating a pawl-arm.

The commutator-brush holders are connected mechanically (but insulated electrically from each other) by a pivoted yoke, which, when turned upon its axis, moves the brushes around upon the cylinder. The yoke may be turned by means of a worm and worm-wheel actuated by a ratchet-wheel. Two ratchet-wheels are used adapted to turn in opposite directions, and each operated by one of the pawl-arms above spoken of. When the electro-motive force of the circuit is too great it is desirable to decrease the electro-motive force of the machine by moving the commutator-brushes farther away from the neutral line of the cylinder. The magnet in the multiple-arc circuit of course has its energy increased by the excessive quantity of current passing through it from the main line and attracts its armature, which pushes the spring-arm against a contact-point, thus closing a division of the shunt including one or the other of the electro-magnets, whose vibrating armature is set in motion, moving the pawl and turning the ratchet-wheel, worm-gearing, and pivoted yoke in such a direction as to move the commutator-brushes away from the neutral line. The electro-motive force in the main circuit then decreases and the magnet in the multiple-arc circuit weakens in power until the armature is drawn away by the spring and the circuit of the electro-magnet which actuates the pawl-arm is broken; but if the electro-motive force is very much decreased, so that it becomes necessary to move the brushes back again, the first armature-lever is drawn back by its spring and closes the other division of the shunt-circuit through the other electro-magnet, whose pawl-arm, acting on the other ratchet-wheel, moves the brushes in the opposite direction.

Instead of using the two vibrating motors moving the commutator-brushes in opposite directions, the circuit to one or the other being completed, as required, by a controlling electro-magnet in multiple arc having a cen-

tered armature-lever, I may employ a single revolving electromotor connected with a current-reverser which is operated by said controlling electro-magnet, which causes the motor to turn in one direction or the other. The armature-lever of this controlling electro-magnet is centered, as before described, and in its central position opens the motor-circuit entirely.

In the drawings, Figure 1 is a view, partly diagrammatic, of the arrangement employing two vibrating motors; and Fig. 2, a similar view of the arrangement employing the single revolving motor.

A is the armature; B, the commutator-cylinder, and *a a* the brushes, held in brush-holders C C.

To a sleeve, *c*, on the armature-shaft is attached the yoke *b*, on each end of which is placed one of the brush-holders C C, which, however, are insulated from the yoke by non-conducting material *d*. Attached also to the sleeve *c* is the worm-wheel *e*, which is moved by the worm *e'*, this being turned in one direction or the other, according to which of the ratchet-wheels *f f'* is in operation. The ratchet-wheel *f* is turned by means of the pawl *g*, which is attached to the vibrating armature *h* of the electro-magnet D, which is placed in the division *i* of the shunt-circuit 5 6, which is a shunt from the multiple-arc circuit 7 8, derived from the main conductors 1 2 of the system. The armature *h* is provided with a spring, *l*, and is pivoted at *m*. Its lower end is placed between the branches of the pivoted U-shaped piece *n*, which forms a circuit-breaker. When the magnet D is energized by the completion of the circuit 6 *i* it draws forward its armature, which then throws back the piece *n* and breaks the circuit at *o*. The spring *l* then draws back the armature and throws *n* against *o* again completing the circuit through the magnet. The piece *n* is provided with a spring, *s*, to assist its motion. The vibration of the armature which actuates the pawl-arm is thus produced. On the opposite side of the drawings the magnet B', armature *h'*, and circuit-breaker *n'* operate the pawl *g'* and ratchet *f'*, the magnet D' being in the other division, 6 *i'*, of the shunt 5 6.

The electro-magnet E is placed directly in the multiple-arc circuit 7 8. Its spring-armature F is a part of the shunt-circuit 5 6. The free end of this armature, with the spring-arm *p*, is between the contact-points *i i'*, and as it is attracted by its magnet or drawn back by its spring, according to the variations in the energy of the magnet, it makes and breaks the circuits 6 *i* and 6 *i'*. An adjustable resistance, G, is used to regulate the amount of current passing into the shunt.

Instead of the above-described arrangement, that shown in Fig. 2 may be employed. Here the magnet E is in multiple-arc circuit 9 10, and its armature F forms part of a shunt, 11 12, around resistance in a multiple-arc circuit, 13 14. In the shunt 11 12 is placed a revolving electromotor, W, of which S is the armature and T the commutator-cylinder. The worm *e'* is on the end of the commutator-shaft U, so that the worm-wheel *e*, and consequently the brushes *a a*, are moved by the revolution of the armature S, but of course at a much lower speed than said armature.

V is a current-reverser, operated by the movement of the armature-lever F to reverse the current energizing the motor W. Thus when the armature F is drawn forward the motor W runs in the proper direction to move the commutator-brushes *a a* away from the neutral line, and when armature F is retracted by its spring the current through the motor is reversed, whereby the commutator-brushes are moved toward the neutral line. The armature-lever F is centered between springs *t t'*, and in its central position breaks completely the motor-circuit.

What I claim is—

1. The combination, with the commutator-brushes of a dynamo or magneto electric machine, of one or two electromotors capable of continuous operation and adapted to move such brushes in either of two directions, and an electro-magnet located in a multiple-arc circuit and controlling such motor or motors, substantially as set forth.

2. The combination, with the commutator-brushes of a dynamo or magneto electric machine, of one or two electromotors capable of continuous operation and adapted to move said brushes in either of two directions, an electro-magnet located in a multiple-arc circuit, the armature-lever of said electro-magnet controlling such motor or motors, and means for determining the central position of said armature-lever, substantially as set forth.

3. The combination, with an electro-magnet energized by the current generated by a dynamo or magneto electric machine, of an armature-lever, a divided shunt closed by the forward and backward movements of said armature-lever, and mechanism, included in the branches of said divided shunt, for changing the position of the commutator-brushes of the machine, substantially as set forth.

4. The combination, with a multiple-arc circuit, of a divided shunt therefrom, each division containing an electro-magnet provided with a vibrating armature, and mechanism operated by said vibrating armature for shifting the position of the commutator-brushes of the machine, substantially as set forth.

This specification signed and witnessed this 17th day of January, 1882.

THOMAS A. EDISON.

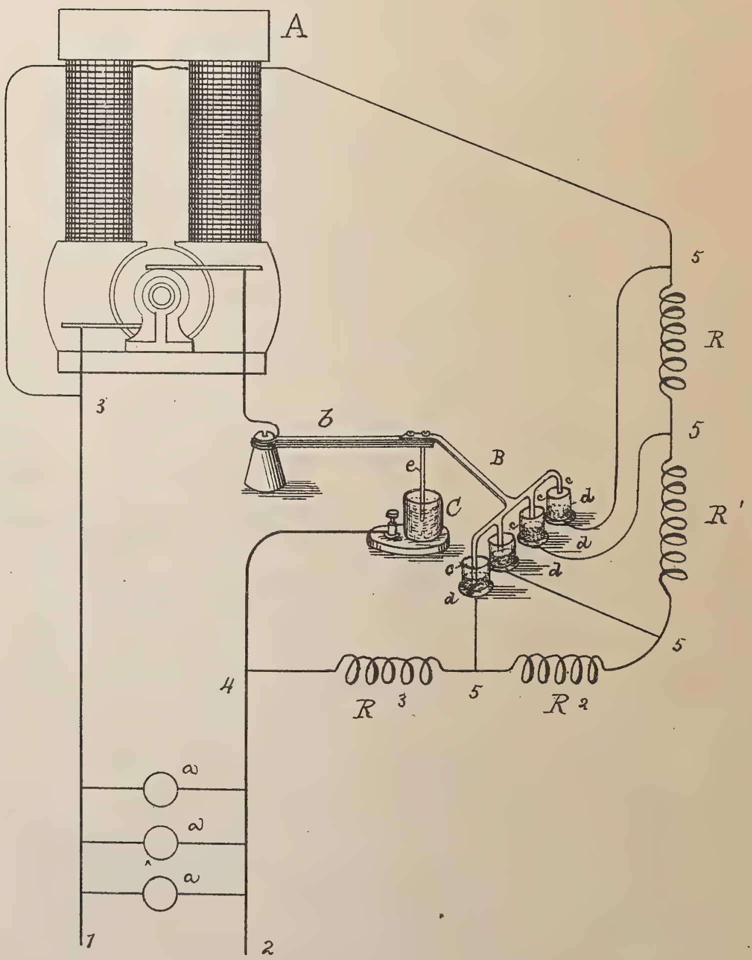
Witnesses:
H. W. SEELY,
PHIL. S. DYER.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 265,780. Patented Oct. 10, 1882.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer.

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 265,780, dated October 10, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulating the Generative Capacity of Dynamo or Magneto Electric Machines, (Case No. 402;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of my invention is to produce means for regulating the generation of current by a dynamo or magneto electric machine supplying a multiple-arc system of electrical distribution which shall be caused to operate by the thermal effect of the current generated. To accomplish this I place in one of the conductors of the main circuit a metal strip or bar which will be heated by the passage of current through it. This bar is so placed that its expansion and contraction, caused by variations in such heating, will cause the opening and closing of circuits, such opening and closing causing variations in the current energizing the field-magnet of the generator, the coils of which magnet are preferably included in a multiple-arc circuit or circuits from the main conductors, though, if desired, the magnet may be energized from any external source.

A convenient form of my invention is one in which a double strip composed of two metals of different degrees of expansion is placed in the main circuit and held rigidly at one end, but free at the other, the circuit being completed at the free end by means of a point dipping into a mercury-cup. An arm is attached to the free end of the strip, which arm carries a number of contact-points, each dipping into a mercury-cup, the contact-points being of different lengths, or the mercury of different heights, in order that successive contacts may be made and broken. In the multiple-arc circuit which includes the field-magnet is placed a series of resistances, around each of which is formed a shunt including one of the mercury-cups. When the number of lamps or translating devices in multiple-arc on the main conductor is increased the increase of current causes the heating of the compound bar, the unequal expansion of which causes said bar to bend downward, which lowers the end of the arm carrying the contact-points, which, as they successively dip into the mercury-cups, cause the closing of the shunts around the resistances in the field, and thus increase the generative capacity of the machine. A decrease in the number of translating devices causes a contrary effect, the shunt-circuits being opened and the resistances again placed in circuit.

Instead of opening and closing circuits around resistances, this arrangement may be used to open and close new circuits through the coils of the field-magnet, as shown in Case No. 68,618, of even date herewith, such coils being for this purpose divided into a number of separate sections or bobbins each included in a different circuit.

My invention may be more readily understood by reference to the annexed drawing, which is a diagrammatic view, illustrating the arrangement just described.

A is a dynamo electric machine, and 1 2 the main conductors leading therefrom, on which are placed in multiple-arc circuits lamps or other translating devices, *a a a*.

3 4 is a multiple-arc circuit energizing the field-magnet of the generator and containing resistances R R′ R² R³. In main conductor 1 is placed the compound strip *b*, at whose free end the point *e* dips in the mercury-cup C, and which has secured to it the arm B, carrying contact-points *c c*, each dipping into a mercury-cup, *d*. Wires 5 5 from the field-circuit 3 4 form shunts around the resistances R R′ R² R³.

The operation of these devices is as above described.

What I claim is—

1. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of a resistance in the field-circuit, mercury-cups connected with such resistance at intervals, and a thermostatic device in the main circuit carrying points which dip into said mercury-cups in succession, substantially as set forth.

2. The combination of a multiple-arc circuit including the coils of the field-magnet of a dy-

namo-electric machine, a multiple-arc circuit including the armature of said machine, multiple-arc circuits containing lamps or other translating devices, (all such multiple-arc circuits being derived from the same main conductors,) a resistance in the field-circuit, mercury-cups connected with such resistance at intervals, and a thermostatic device in the main circuit carrying points which dip into said mercury-cups in succession, substantially as set forth.

This specification signed and witnessed this 28th day of February, 1882.

THOMAS A. EDISON.

Witnesses:

H. W. SEELY,

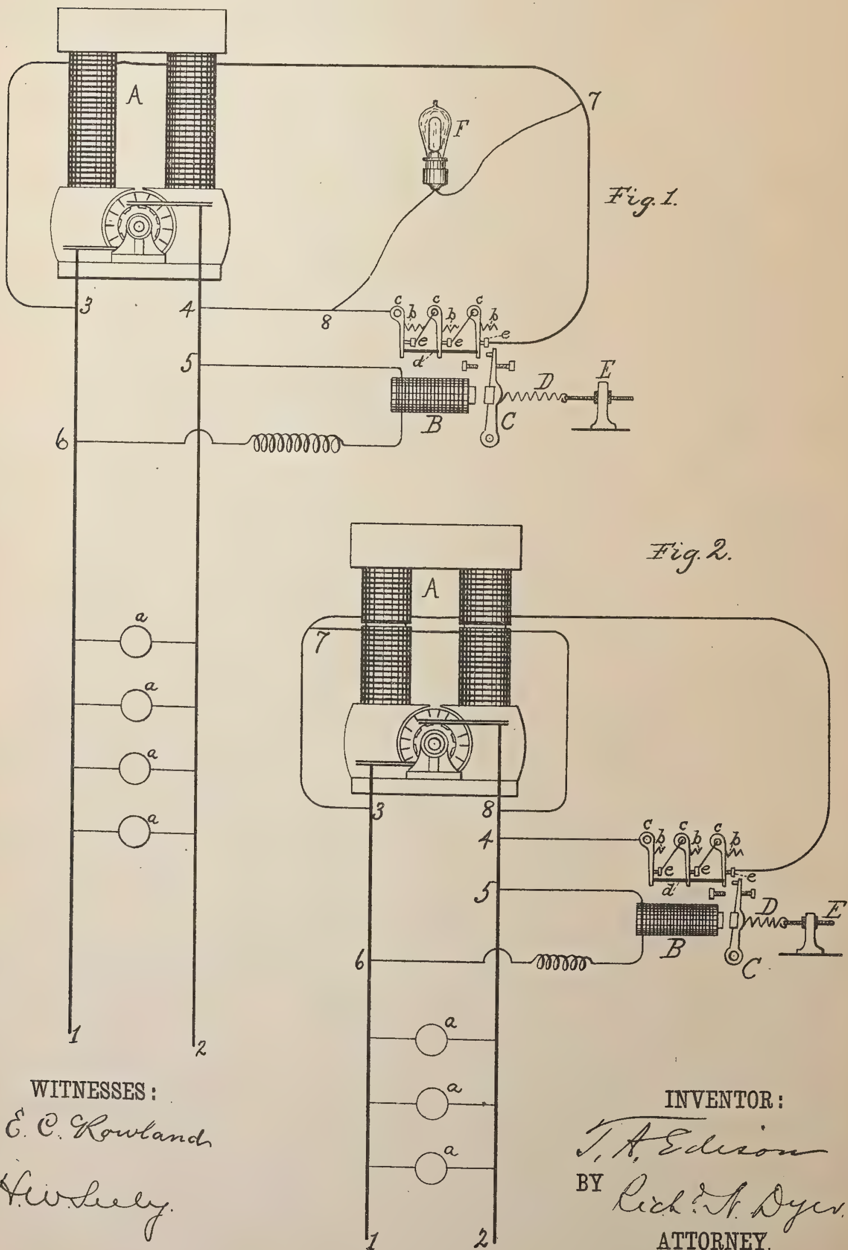
THOMAS JOHNSTON.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 265,781. Patented Oct. 10, 1882.



WITNESSES:

E. C. Rowland

H. W. Seely.

INVENTOR:

T. A. Edison

BY Rich^d. N. Dyer.

ATTORNEY.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 265,781, dated October 10, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Regulation of Dynamo or Magneto Electric Machines, (Case No. 405;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of my invention is to produce a new method of and means for regulating the generation of current by a dynamo or magneto electric machine supplying current to a multiple-arc system of electrical distribution, which shall operate automatically upon the addition or removal of translating devices in the system, and shall not act to vary the resistance of or the current flowing through the field-of-force circuit of the machine.

My invention consists, first, in employing a vibrating circuit-controller operated by the current generated, the vibrations of which produce vibrations or rapid and successive openings and closings of the circuit energizing the field-magnet, such vibrations properly regulating the energy of the field-magnet, and therefore the generation of current by the machine, the length and duration of the vibrations being controlled by the number of translating devices in circuit, and also by variations in the speed of the engine which drives the generator; and, second, in various devices and combinations of devices for accomplishing this result, as will be more fully set forth. This may be accomplished by placing an electro-magnet in a multiple-arc circuit from the main conductors and in the field-circuit a vibrating circuit-controller, which should be one so constructed as to make and break contact at a number of points simultaneously, so that the spark due to such breaking will be reduced. This circuit-controller is preferably operated by the backward and forward movement of the pivoted spring-armature of the electro-magnet. It will be seen that when the field-circuit is closed at this point, as its resistance is low, much too large a current will pass through it; but when the circuit is open no current at all will pass. Thus a constant and rapid vibration of the circuit-controller will cause the proper energization of the field-magnet. Such vibrations, are kept up automatically and continuously, whether many translating devices or none at all are in circuit; but differences in the number of translating devices in circuit, and also variations in the speed of the engine by varying the energy of the electro-magnet, vary also the relative durations of the openings and closings of the field-circuit according to the requirements of the system. If desired, in order to still further reduce the spark, and to produce a constant current for primarily energizing the field-magnet, a shunt may be made from the field-circuit around the circuit-breaker containing a high resistance, one of my incandescing electric lamps being preferably placed therein for this purpose; or such shunt may include a portion of the field-magnet coils. These arrangements are of course equivalent to entirely breaking the circuit. The armature-lever may be so arranged that the tension of its spring is adjustable, so that the relative durations of make and break, and consequently the current generated, and the candle-power of the lamps in the main circuit, may be regulated. This may be better understood by reference to the drawings, in which—

Figure 1 is a diagram showing the form of my invention, in which a lamp is placed in the shunt around the circuit-controller; and Fig. 2 shows the form in which the shunt includes a portion of the field-magnet coils.

A is a dynamo-electric machine, from which lead main conductors 1 2, containing translating devices *a a*, placed in multiple arc.

3 4 is the circuit energizing the field-magnet of the generator. This circuit contains a vibrating circuit-controller which makes and breaks contact at a number of points simultaneously. It is composed of a number of pivoted arms, *c c c*, each provided with a spring, *b*, and connected together by an insulating-pin, *d*. A corresponding number of contact-points, *e e e*, are used, connected as shown, so that when all the arms swing forward simultaneously the circuit is broken between each arm and its contact-point.

In a multiple-arc circuit, 5 6, is placed an electro-magnet, B, provided with a pivoted armature, C, retracted by a spring, D. An adjust-

ing device, E, is used to regulate the tension of the spring, so as to control the length of the vibrations of the armature.

Referring to Fig. 1, in a shunt-circuit, 7 8, around the circuit-breaker is placed an incandescing electric lamp, F, of high resistance. This may, however, be dispensed with altogether; or instead of the lamp any sufficiently-high resistance may be used. The armature C is so placed that when drawn forward by the magnet B it throws the circuit-breaking arms *c* back from their contacts, and when the armature is retracted the spring contact-arms follow it and again complete the circuit. It is evident that these vibrations will be continuous so long as the generator is in operation, whether lamps are in circuit or not.

In Fig. 2 the shunt 7 8 includes a portion of the coils of the field-magnet.

The operation of these devices is as hereinbefore explained.

It is evident that any other suitable form of vibrating circuit breaker might be used, though it should preferably be one which breaks the circuit at several points simultaneously.

Instead of the field-circuit 3 4 being a derived circuit from the main line, it may be a circuit supplied from an external source; or a shunt-circuit from the main line may energize the field, the circuit-breaker being placed therein; or in a dynamo-machine in which the main current passes through the field such circuit-breaker may be placed in a shunt around the field for regulating the latter.

What I claim is—

1. The combination, with a dynamo or magneto electric machine and its regulating-circuit, of a continuously-vibrating circuit-controller acting to open and close said circuit rapidly for regulating the generation of current by the machine, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine and its regulating-circuit, of a continuously-vibrating circuit-controller adapted to make and break said circuit at several points simultaneously for regulating the generation of current by the machine, substantially as set forth.

3. The combination, with a dynamo or magneto electric machine and its regulating-circuit, of a continuously-vibrating circuit-controller acting to open and close said circuit rapidly for regulating the generation of current, and an electro-magnet energized by said current for operating said circuit-controller, substantially as set forth.

4. The combination, with a dynamo or magneto electric machine and its regulating-circuit, of a vibrating circuit-controller for regulating the generation of current, and an electro-magnet for operating said circuit-controller, located in a multiple-arc circuit from said machine, substantially as set forth.

5. The combination of the vibrating circuit-controller located in the field-circuit of the generator, and the electro-magnet for operating the same, located in a multiple-arc circuit from said generator, substantially as set forth.

6. The combination of a dynamo or magneto electric machine, its regulating-circuit, and translating devices arranged in mutiple-arc, with a continuously-vibrating circuit-controller acting to open and close said regulating-circuit rapidly for regulating the generation of current by the machine, substantially as set forth.

7. The combination of a multiple-arc circuit including the field-magnet coils of a dynamo-electric machine, a multiple-arc circuit including the armature-coils of said machine, multiple-arc circuits containing lamps or other translating devices, all said multiple-arc circuits being derived from the same main conductors, and a continuously-vibrating circuit-controller acting to open and close a circuit rapidly for regulating the generation of current by said machine, substantially as set forth.

8. The combination, with a dynamo or magneto electric machine and its regulating-circuit, of a continuously-vibrating circuit-controller acting to open and close said circuit rapidly for regulating the machine, and a spark-arresting shunt around such circuit-controller, substantially as set forth.

9. The combination, with a dynamo or magneto electric machine and its regulating circuit, of a continuously vibrating circuit-controller acting to open and close said circuit rapidly for regulating such machine, and an adjustable retractor for regulating the make and break, substantially as set forth.

This specification signed and witnessed this 28th day of February, 1882.

THOMAS A. EDISON.

Witnesses:

H. W. SEELY,

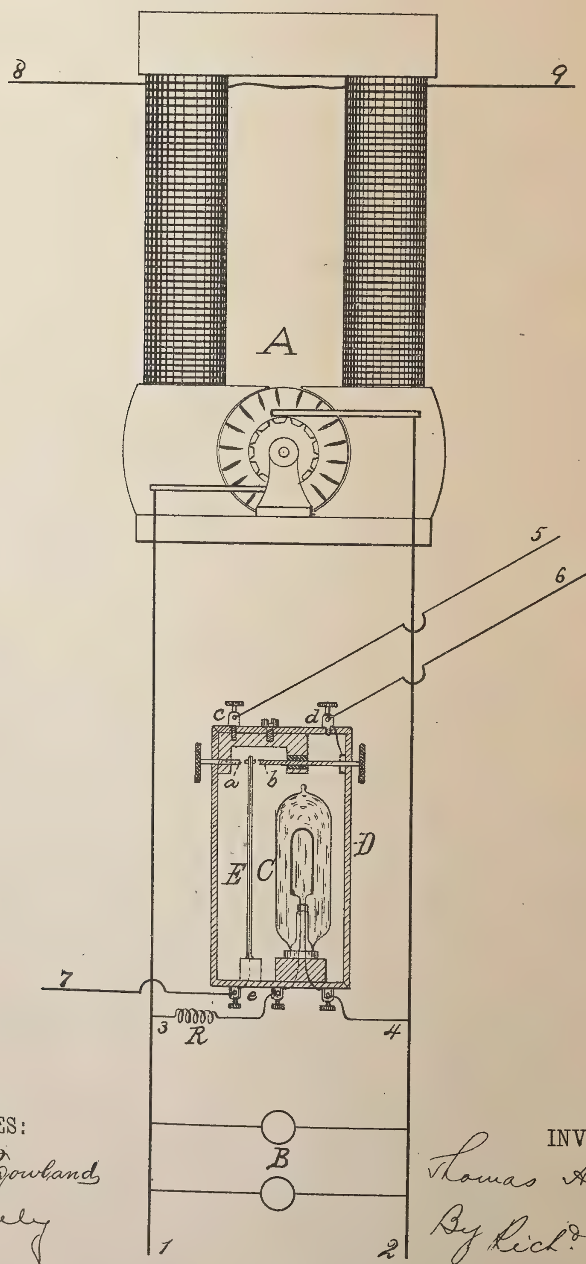
THOMAS JOHNSTON.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 265,782. Patented Oct. 10, 1882.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer.

Att'y.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 265,782, dated October 10, 1882.

Application filed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Regulating Electrical Generators, (Case No. 460;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of the present invention is to produce means for controlling electrical mechanism, regulating the generative capacity of dynamo or magneto electric machines, which means will be simple in construction and efficient in operation, and will be affected exactly as are the lamps, motors, or other translating devices, by changes in the speed of the engine, as well as by changes in the number of translating devices in circuit.

The object is more especially to control dynamo or magneto electric machines supplying translating devices located in separate multiple-arc circuits and independently controllable.

The object is accomplished by utilizing for the purpose the heating effect of the current, the current of a multiple-arc circuit being employed, so that the controlling devices will be affected exactly the same as the translating devices of the system by changes in speed of engine, as well as in number of translating devices. The preferred form of the controlling device is an incandescing electric lamp or other form of heating-resistance, which is located in a multiple-arc circuit, with or without extra resistance, and is inclosed within a suitable case in which is located a thermostatic device which closes the circuit to the operating mechanism. A compound spring may be employed, the free end of which, when the electro-motive force is normal, will stand centrally between two contact-points. These contact-points are connected with different branches of the circuit through the operating mechanism, while the thermostatic spring is also in the circuit of the operating mechanism. Now, if there is a drop in the electro-motive force, the lamp will be affected and the spring will make one contact and complete a circuit through the operating mechanism, causing the same to operate and adjust the generator for greater electro-motive force, while if there is a definite increase in the electro-motive force above the normal the thermostatic spring will make the other contact and complete another circuit through the operating mechanism, working it in the opposite direction and causing it to adjust the generator for a lower electro-motive force.

The operating mechanism may be an electro-magnetic mechanism arranged to throw resistance into and out of the field-circuit, as described in my application No. 375, (Serial No. 68,603;) or for adjusting the commutator-brushes, as described in my application No. 391, (Serial No. 68,614;) or for adjusting a circuit-breaker, as described in my application No. 461, (Serial No. 69,259,) or for regulating the generative capacity of the dynamo or magneto electric machine in any other way.

It is evident that in connection with the lamp or other heating-resistance a reflector may be used to concentrate the heat-rays upon the thermostatic spring; also, that the thermostatic spring, instead of being straight, may be coiled around the lamp; also, that the heat of the lamp or other form of heating-resistance may be used to work all known forms of expansion apparatus—such, for instance, as air or other gas working upon a diaphragm or on a mercury column or a mercury column affected directly by the heat.

The foregoing will be better understood by reference to the drawing, which is a view, partly diagrammatic, of the preferred form of the thermostatic controlling device.

A represents a dynamo or magneto electric machine, from which run the main conductors 1 2 in multiple-arc circuits, from which are the lamps, motors, or other translating devices B. In a multiple-arc circuit, 3 4, with or without extra resistance R, is located an incandescing electric lamp, C, or any other form of heating-resistance, such as a wire or carbon resistance inclosed within a case, D. In this case is arranged a compound thermostatic spring, E, which normally stands between two adjustable screw-contacts, *a b*. These are connected with binding-posts *c d*, from which run the conductors 5 6.

The thermostatic spring is connected with a binding-post, *e*, from which runs another conductor, 7. These conductors 5, 6, and 7 may form parts of the circuits through an operating

mechanism for throwing resistance into and out of the field-circuit, or for adjusting the commutator-brushes or adjusting a circuit-breaker, as described in my applications Nos. 375, 391, and 461, before referred to. The ends 8 9 of the coils of the field-magnet may be connected with the conductors 1 2, or the field-circuit may be supplied from an external source. When the electromotive force is normal spring E will stand centrally between *a* and *b*, breaking both divisions of the circuit through the operating mechanism. Now, if the electromotive force increases, spring E will make one contact—say *a*—and a division of the circuit through the operating mechanism will be completed, causing it to work in one direction and adjust the machine for a lower electro-motive force. If the electro-motive force decreases below the normal electro-motive force, spring E will make contact *b*, and will complete the other division of the circuit through the operating mechanism, causing it to work in the opposite direction and adjust the machine for a higher electro-motive force.

What I claim is—

1. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of an electrical heating device arranged in mutiple arc, circuits for regulating the generator, and a switch controlled by such electrical heating device and closing such circuits at the limits of the normal condition of the current, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine, of a lamp or other heating-resistance and a thermostatic or expansion device affected by the heat of the lamp and circuits closed thereby for controlling the regulation of the machine, substantially as set forth.

3. The combination, with a dynamo or magneto electric machine supplying translating devices in multiple arc, of a lamp or other heating-resistance arranged in multiple arc, and a thermostatic spring affected by the heat of the lamp or other resistance, and circuits closed at the front and back contacts of the spring for controlling the regulation of the machine, substantially as set forth.

This specification signed and witnessed this 7th day of July, 1882.

THOMAS A. EDISON.

Witnesses:

RICHD. N. DYER,

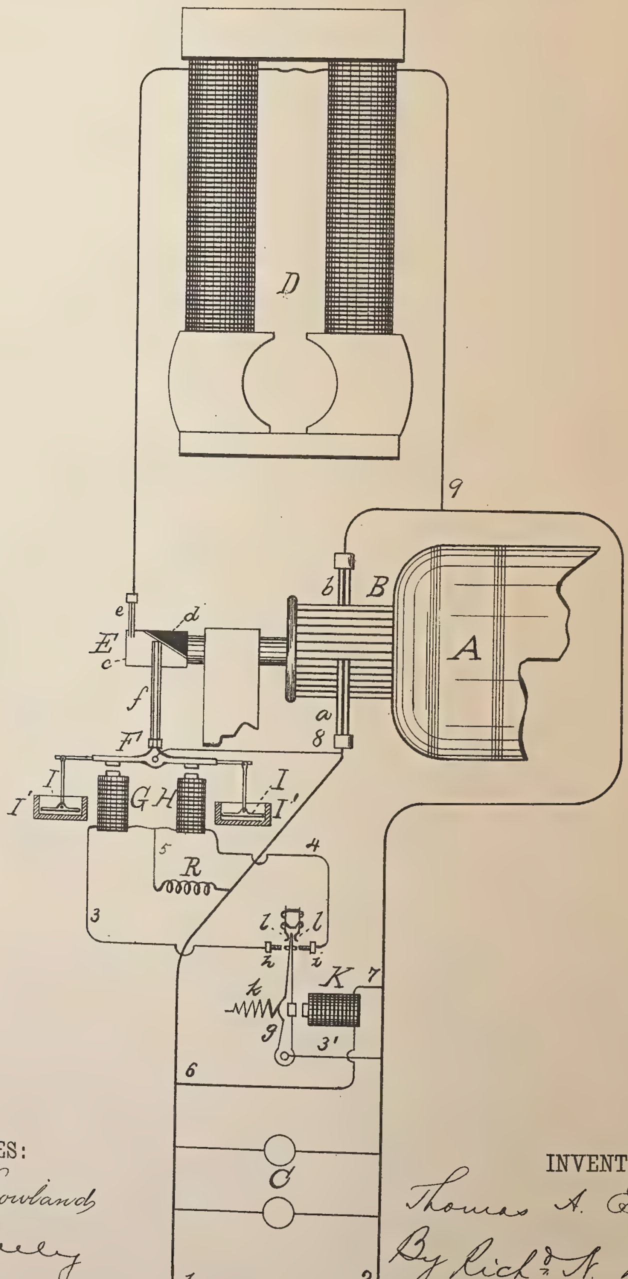
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 265,783. Patented Oct. 10, 1882.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Richd. N. Dyer,
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 265,783, dated October 10, 1882.

Application filed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Regulating Electrical Generators, (Case No. 461;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of the present invention is to produce means for automatically regulating the generative capacity of dynamo or magneto electric machines, which means will be simple and compact in construction, avoiding the use of bulky resistances, and, further, will be efficient in operation, regulating both for changes in the speed of the engine and in the number of translating devices in circuit. The means are applicable more especially to dynamo or magneto electric machines supplying lamps, motors, or other translating devices arranged in independent multiple-arc circuits. The object is accomplished by the use of a peculiar circuit-breaker located in the field-circuit of the machine and controlled by an electro-magnet or other electrical controlling device arranged in multiple-arc and affected the same as the lamps by variations in electro-motive force caused by changes in the speed of the engine as well as by changes in the number of translating devices.

In carrying out the invention there is used a revolving cylindrical circuit-breaker, which is divided up between metal and insulation on a plane arranged obliquely to the axis of rotation, the insulation and metal having a tapering shape. By this construction the circuit-breaking cylinder is made to present in revolving various proportions of insulation and metal at different points of its length. At one end of the cylinder the insulation predominates largely, while toward the other end the insulation regularly diminishes to a point. This end of the cylinder has preferably a band of metal extending entirely around the cylinder, upon which rests a stationary brush or spring. A movable brush is carried by a pivoted bar, and rests upon the circuit-breaking cylinder at points varying from the stationary brush to the other end of the cylinder. This pivoted bar is moved by two electro-magnets arranged on opposite sides of its pivot, and its movement is retarded and made regular by means of one or two reciprocating dash-pot plungers, which are preferably of large area and work against the retarding force of the air. The circuits of these electro-magnets are made and broken at the contacts of the armature-lever of an electro-magnet arranged in multiple arc, or by a thermostatic device, so that the movable brush or spring will be adjusted upon the breaking-cylinder and will keep the field-circuit open more or less of the time, according to whether the electro-motive force is above or below the normal limit.

The foregoing will be better understood by reference to the drawing, which illustrates an apparatus embodying the invention, the armature of the generator being separated from the field-of-force magnet for clearness of illustration.

A is the revolving armature of a dynamo or magneto electric machine, and B the commutator-cylinder of the same, upon which rest the commutator-brushes *a b*, connected with the main conductors 1 2.

C represents lamps, motors, or other translating devices, arranged in separate multiple-arc circuits from 1 2.

D is the field-of-force electro-magnet of the generator.

E is a revolving circuit-breaking cylinder, divided between metal *c* and insulation *d* on a plane oblique to the axis of rotation, the metal and insulation haying a tapering form, as shown, and the metal forming a complete band at its large end. This circuit-breaking cylinder may be mounted upon the armature-shaft, as shown, or it may be on a separate shaft worked from any moving part of the generator or engine, or it could be revolved by a small electromotor or by a spring or weight operated mechanism. A stationary brush or spring, *e*, rests upon the band of metal at the end of *c*, while a movable brush, *f*, rests upon the cylinder E, between the brush *e* and the other end of the cylinder. This movable brush *f* is carried by a centrally-pivoted bar, F, the position of which is controlled by two electro-magnets, G H. The bar F is connected with one or more reciprocating dash-pot plungers, I, which are preferably of large area and work against the resisting force of the air in cylinders I′,

closed at one or both ends. The magnets G H are energized from any suitable source, a multiple-arc circuit from 1 2 being shown as used for the purpose. This circuit is formed of a connection, 3′, running from 2 to an armature-lever, *g*, and from the contacts *h* *i* of that lever, by wires 3 and 4, to the coils of magnets G and H. The other ends of the coils of G and H are connected together and to a return-wire, 5, running to conductor 1, extra resistance R being preferably employed in the circuit. The armature-lever *g* is retracted by a spring, *k*, and is held in a central position between contacts *h* *i* by spring-fingers *l*. The electro-magnet K, which attracts *g*, is located in a multiple-arc circuit, 6 7, from 1 2.

The circuit of the field-of-force magnet may be supplied from any suitable source. It is preferably a multiple-arc circuit, 8 9, from 1 2, the brushes or springs *e f* and circuit-breaking cylinder E being included in the circuit. When the electro-motive force is normal, lever *g* will stand in a central position between *h* and *i* and the circuits of magnets G and H will be broken. The bar F will be stationary, and the revolution of the cylinder E will keep the field-circuit open a definite proportion of the time. For convenience of illustration, this may be considered as one-half of the entire time, the brush *f* resting on E at a point where its circumference is divided equally between metal and insulation. Now, if there is an increase of electro-motive force, the lever *g* will make the contact *i*, closing circuit through H and drawing F downwardly on the right of its pivot. The brush F will now rest on E, where the insulation is greater than the metal, and hence the field-circuit will be kept open a greater proportion of the time and the field-magnet will be weakened. If there is a decrease of electro-motive force below the normal, lever *g* will make contact *h* and the circuit of G will be completed, tipping bar F and throwing the movable brush *f* toward *e* to a point on the cylinder E where there is more metal than insulation, and reducing the length of time that the field-circuit is kept open in each revolution of E.

Instead of using the electro-magnet K for controlling G and H, the thermostatic device described in my application No. 460 (Serial No. 69.258) may be employed.

What I claim is—

1. The combination, with a dynamo or magneto electric machine, of a circuit-breaker for regulating the generative capacity of the machine and means controlled by the current for varying the proportion of make and break, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine, of a revolving circuit-breaking cylinder having a surface of tapered insulating material and metal, a movable brush or spring, and a mechanism controlled by the current and adjusting said movable brush or spring upon the breaking-cylinder, for regulating the generative capacity of the machine, substantially as set forth.

3. The combination, with a dynamo or magneto electric machine, of a revolving circuit-breaking cylinder located in the field-circuit and having a surface of tapered insulating material and metal, a movable brush or spring, oppositely-working electro-magnets for adjusting said movable brush or spring, and a controlling device arranged in multiple arc, substantially as set forth.

4. The combination, with a dynamo or magneto electric machine, of a revolving circuit-breaking cylinder located in the field-circuit of the machine and having a surface of tapered insulating material and metal, an adjustable brush or spring, a pivoted bar for adjusting such brush or spring, two electro-magnets acting oppositely and separately upon such bar, means located in multiple-arc for controlling the circuits to said electro-magnets, and one or more dash-pots for retarding the movement, substantially as set forth.

This specification signed and witnessed this 7th day of July, 1882.

THOMAS A. EDISON.

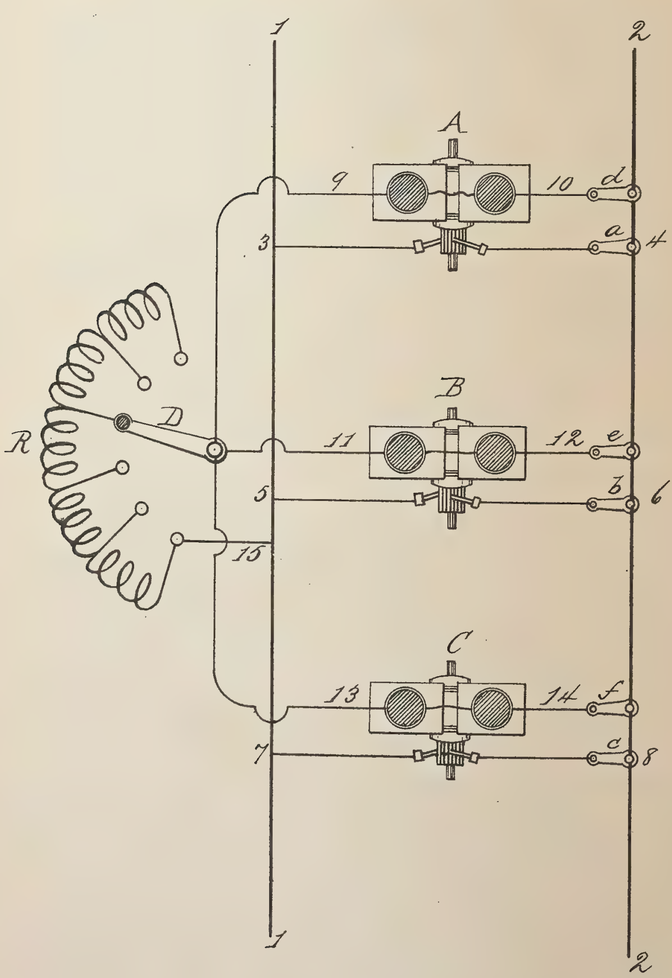
Witnesses:
RICHD. N. DYER,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 265,784. Patented Oct. 10, 1882.



WITNESSES:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Rich^d N. Dyer
Att'y.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 265,784, dated October 10, 1882.

Application filed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Operating and Regulating Electrical Generators, (Case No. 465;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of the present invention is to produce a simple and efficient method of disconnecting and connecting the separate machines of a number of dynamo or magneto electric machines having their armature and field-coils in independent circuits, such machines running together and feeding into the same conductors, or into the same connected system of conductors, so that the armatures of the machines will not be destroyed by an excessive flow of current; and a further object is to produce simple and efficient means for regulating simultaneously a number of dynamo or magneto electric machines having the coils of their field-magnets in separate multiple-arc circuits.

The first object is accomplished by breaking the armature-circuit before the field-circuit is broken in disconnecting each machine, the reverse order being observed in completing the connections of each machine, the field circuit being completed first. The armature-coils of the machines are arranged in independent cross-circuits connected with the same conductors or system of conductors, and the field-circuits are also independent cross or multiple-arc circuits supplied from the conductors with which the armatures of the machines are connected, or from a separate source of electrical energy, all of such independent circuits being provided with separate circuit-controllers. When a number of dynamo or magneto electric machines have their armature-coils connected with the same conductors and have their field-magnet and armature-coils in separate circuits, the breaking of the field-circuit before the armature-circuit of a machine or the completing of the armature-circuit before the field-circuit would cause the armature-coils to be burned out, since they would form a short circuit, or one of such low resistance that an excessive current from the other machines would flow through the circuit and heat the wire so as to fuse it at some point; but by always having the field-coils in circuit while the circuit of the armature-coils is closed the field-magnet will be energized and the armature will have an electro-motive force equal to that of the other machines.

The second object is accomplished by running all the multiple-arc field circuits through a common resistance and regulating all the machines simultaneously by throwing more or less of the resistance into and out of circuit, as required, by means of a hand-operated or an automatic device. The field-circuits are, however, independent of each other, and can be made and broken separately.

The foregoing will be better understood from the drawing, which is a view, partly diagrammatic, of three machines and connections, a top view of the machine being shown with the field-magnets in horizontal section.

A B C represent dynamo or magneto electric machines the armature-coils of which are in separate multiple-arc circuits from main conductors 1 2, such separate multiple-arc circuits being shown at 3 4 and 5 6 and 7 8, and being controlled by separate circuit-controllers *a b c*.

The field-circuits of the machines are independent multiple-arc circuits 9 10 and 11 12 and 13 14, extending from 2 through the coils of the field-magnets to the contact-arm D of an adjustable resistance, R, from which runs a conductor, 15, to the main conductor 1, common to all the field-circuits. The multiple-arc field-circuits are controlled by separate circuit-controllers *d e f*. The field-circuits may be supplied from an external source of electrical energy, if desired.

The machines are driven from one or more steam-engines or other motors, and are always running when the connections are made or broken.

In disconnecting any one machine the armature-circuit is broken by the circuit-controller *a*, *b*, or *c* before the field-circuit is broken by its circuit-controller *d*, *e*, or *f*, and in connecting any machine the field-circuit is completed before the armature-circuit.

The machines are regulated simultaneously by adjusting the arm D; but the field-circuits are independently controllable at *d*, *e*, and *f*.

What I claim is—

1. The combination of two or more dynamo or magneto electric machines having their field-coils in independent circuits and their armature-coils in independent circuits connected with the same conductors or system of conductors, with separate circuit-controllers for all of such independent circuits, whereby the connections can be made and broken in the order stated, substantially as set forth.

2. The combination, with two or more dynamo or magneto electric machines having their armatures in separate multiple-arc circuits, of a multiple-arc circuit having an adjustable resistance and branches from the resistance through the field-magnets of the machine, such resistance being common to all of said branches, substantially as set forth.

This specification signed and witnessed this 7th day of July, 1882.

THOMAS A. EDISON.

Witnesses:

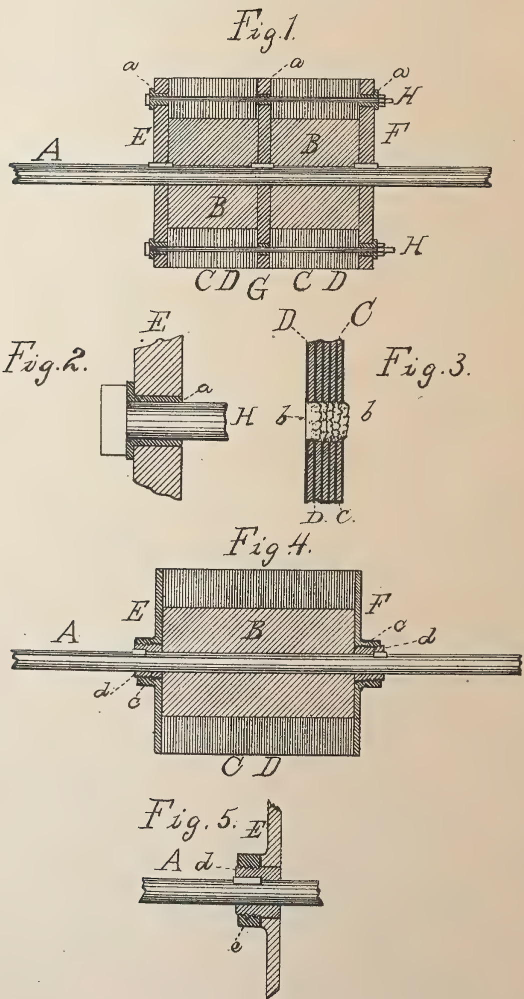
RICHD. N. DYER,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 265,785. Patented Oct. 10, 1882.



WITNESSES:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer.
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 265,785, dated October 10, 1882.

Application filed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 462;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is such an improvement upon the solid cylindrical armature-cores of dynamo or magneto electric machines, having a continuously-wound bobbin, composed wholly of wire or of longitudinal bars and suitable cross-connecting disks or plates, that the circulation of Foucault currents in the core will be in a greater measure prevented than heretofore, and the machine will be made more efficient by reason of better obviating the loss of energy caused by this generation of heat; and a further object is to produce simple and efficient means for this purpose.

This invention relates more especially to an improvement in matter of detail upon the construction described in my application No. 5,537, filed March 20, 1880.

The object is accomplished by constructing the armature-core of an interior core of wood or other suitable insulating material, which is slipped upon the shaft of the armature, and serves to support the magnetic portion of the armature-core, composed of iron rings made of thin sheet metal, of from ten to twenty thousandths of an inch in thickness, (more or less,) divided by rings of insulating material, tissue-paper being preferred for the purpose. Clamping-plates of cast-iron are used at the ends of the armature-core, and if the core is long enough to require it one or more intermediate clamping-plates may be used, which may be plates extending to the shaft and requiring a division of the interior wooden core; or the intermediate clamping-plates may be rings resting like the thin sheet-iron rings upon the wooden core. The clamping-plates are preferably drawn and secured together by means of bolts passing through the clamping-plates and through the rings of thin sheet-iron and tissue-paper. Thimbles of proper insulating material—such as vulcanized fiber—are placed around the bolts, where they pass through the clamping-plates, to prevent the circulation of currents between such clamping-plates. The clamping-bolts are also insulated from the thin sheet-iron rings. This is done by punching the holes in the sheet-iron rings slightly larger than the bolts and forcing such bolts through the rings of tissue-paper, which are not punched in advance, causing such tissue-paper to pack in the holes around the bolts, protecting the edges of the sheet-iron rings and effectively insulating such rings from the bolts. In this way the circulation of currents between the thin sheet-iron rings along the clamping-bolts is prevented. The clamping-plates are keyed or otherwise secured to the armature-shaft, making of the whole a rigid and strong structure.

Instead of using bolts to secure the clamping-plates together, such plates may have screw-threaded hubs turning upon screw-threaded metal thimbles keyed or otherwise secured to the armature-shaft; or the clamping-plates may be slipped upon such thimbles and secured by nuts turning upon the thimbles and impinging against the clamping-plates, forcing such clamping-plates upon the rings of thin sheet-iron and tissue-paper. After the clamping-plates are secured the armature-core is mounted in a lathe and turned down smooth, when it will be ready to receive the bobbin, whether composed of wire or of longitudinal bars and suitable cross-connecting disks or plates.

The foregoing will be better understood from the drawings, in which Figure 1 is a longitudinal section of the armature-core; Fig. 2, a separate sectional view of a clamping-plate around a bolt passing therethrough; Fig. 3, a separate sectional view, on an enlarged scale, of portions of several rings of thin sheet-iron and tissue-paper; Fig. 4, a longitudinal section of a modified form of the armature-core; and Fig. 5, a sectional view of the hub of a clamping-plate, showing a further modification.

A is the armature-shaft, and B the interior core, of wood or other suitable insulating material, which may be made in one piece or in two or more sections. The magnetic portion of the armature-core is composed of rings C, of sheet-iron, of from ten to twenty thousandths of an inch in thickness, (more or less,) separated by suitable insulating material, rings D of tissue-

paper being preferably used. These rings of iron and paper are clamped into a solid mass between rigid clamping-plates E F of cast-iron, one or more intermediate clamping-plates, G, Fig. 1, being used if the length of the armature requires such a construction. This intermediate clamping-plate may be a disk extending to the shaft, as shown, and necessitating a division of the wooden core into sections, or it can be made as a ring, resting upon such wooden core. The clamping-plates, are preferably secured together by bolts H, Figs. 1 and 2, which are surrounded by thimbles *a* of insulating material—such as vulcanized fiber—where they pass through the plates, in order to prevent the circulation of currents between the clamping-plates. The clamping-bolts are also insulated from the thin sheet-iron rings by making the holes in the sheet-iron rings slightly larger than the bolts. The rings of tissue-paper are not punched in advance, but the bolts are forced through them, spreading the tissue-paper into the holes over the edges of the sheet-iron rings, as shown at *b* in Fig. 3. The clamping-plates are keyed or otherwise secured to the armature-shaft.

Instead of being secured together by bolts, the clamping-plates may have screw-threaded hubs *c* and be turned upon screw-threaded thimbles *d*, keyed or otherwise secured to the armature-shaft, Fig. 4, or the clamping-plates may be slipped upon these thimbles and be secured by nuts *e*, turned thereon, Fig. 5. After the clamping-plates are secured the armature-core is mounted in a lathe and turned down smooth, when it is ready to receive the bobbin.

I am aware of the description of Schuckert's dynamo-electric machine in Dingler's Polytechnical Journal, volume 223, pages 587 and 588; but I do not believe that such machine embodies the features of construction described by me and essential in the class of machines to which my dynamo or magneto electric machine belongs.

What I claim is—

1. In a solid cylindrical armature-core, the combination of an interior core of suitable insulating material with a magnetic portion composed of rings of thin sheet-iron separated by insulating material, substantially as set forth.

2. An armature-core having its magnetic portion composed of rings of thin sheet-iron separated by insulating material, in combination with clamping-plates, substantially as set forth.

3. In a solid cylindrical armature-core, the combination of the interior core of suitable insulating material with the magnetic portion composed of thin sheet-iron rings separated by insulating material, and the clamping-plates, substantially as set forth.

4. In an armature-core, the combination, with the rings of thin sheet-iron separated by insulation and clamped between plates, of the clamping-bolts insulated from the clamping-plates, substantially as set forth.

5. In an armature-core, the combination, with the thin sheet-iron rings separated by insulation, of clamping-bolts passing through such thin sheet-iron rings and insulated therefrom, substantially as set forth.

6. A solid cylindrical armature-core composed of an interior core of insulating material, a magnetic portion of thin sheet-iron rings separated by insulation, clamping-plates, and clamping-bolts insulated both from the clamping-plates and from the thin sheet-iron rings, the parts being constructed, arranged, and combined substantially as set forth.

This specification signed and witnessed this 7th day of July, 1882.

THOMAS A. EDISON.

Witnesses:
RICHD. N. DYER,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

APPARATUS FOR THE ELECTRICAL TRANSMISSION OF POWER.

No. 265,786. Patented Oct. 10, 1882.

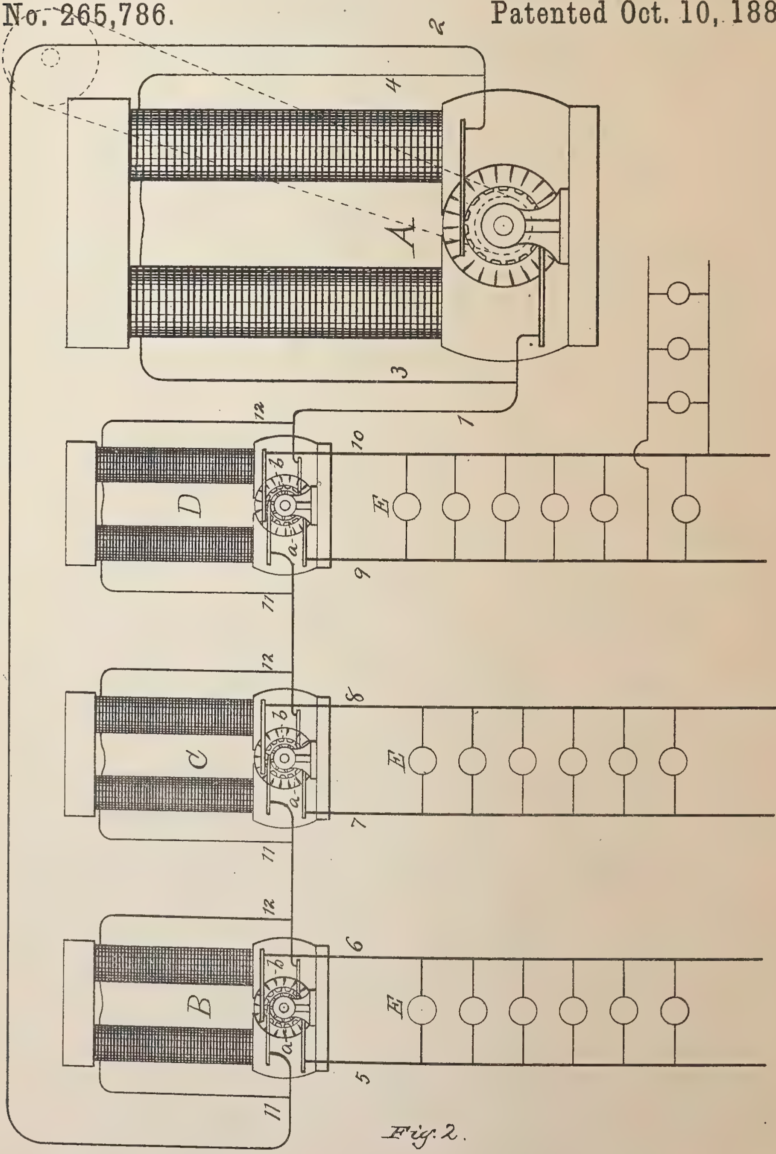
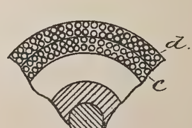


Fig. 1.

Fig. 2.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

T. A. Edison.

BY Rich^d N. Dyer,

ATTORNEY.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

APPARATUS FOR THE ELECTRICAL TRANSMISSION OF POWER.

SPECIFICATION forming part of Letters Patent No. 265,786, dated October 10, 1882.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Apparatus for the Electrical Transmission of Power, (Case No. 423;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce simple and efficient means for transmitting power electrically without a large investment in conductors, and for supplying independent translating devices with electric current of lower tension than that flowing in the main circuit. This I accomplish by supplying a main circuit with a continuous current of high tension by means of one or a number of dynamo or magneto electric machines, and by arranging in series in this main circuit two or more combined electro-dynamic motors and dynamo-electric generators, each of which has two sets of coils upon its armature, connected with independent commutators. The brushes of one commutator are connected with the conductors of the main circuit, while those of the other commutator are connected with conductors with which lamps, motors, or other translating devices are connected in multiple-arc circuits. Each set of coils is a continuous winding upon a cylinder or ring, (the Siemens or Gramme winding,) and one set is connected with the bars of its commutator-cylinder, so as to form with the common field-magnet a complete motor or generator. A continuous current being passed through either set of armature-coils and through the field-coils, the armature will be revolved and the other set of coils will generate a continuous current by cutting the lines of force. One set of coils is in no sense secondary to the other, since they may correspond in resistance and the electro-motive force of the generating-coils be the same as the drop caused by the motor-coils. The field-circuit of each of these machines is a multiple-arc circuit from the main circuit or from its own lamp-circuit. Thus it will be seen that each of these machines will be both a motor and a generator. The tension of the current in the main circuit is much higher than that of the current in each lamp-circuit, and since the combined motors and generators will be located at or near the points of consumption, a great saving in conductors can be made, since the conductors of the main circuit (the only one that need be of any considerable length) can be small. Each combined motor and generator can be regulated independently to give the desired tension in the circuit supplied by it, so that the same tension can be maintained in all the lamp-circuits or a different tension maintained in the same, so as to supply half-lights, if required. Any one of the combined motors and generators can be short-circuited by closing a shunt around it, in which case the electro-motive force could be reduced at the source of supply.

In the accompanying drawings, forming a part hereof, Figure 1 is an arrangement embodying the invention shown diagrammatically, and Fig. 2 is a cross section of a portion of the armature of one of the combined machines.

A represents a dynamo or magneto electric machine supplying a current of high tension in the main circuit 1 2; or a number of machines arranged in multiple arc, in series, or in multiple series could be used for the purpose. The field of the machine A is supplied by a multiple-arc circuit, 3 4, from 1 2, and the machine may be regulated in any known way, preferably by shifting the commutator-brushes or by varying primarily the strength of the field-magnet.

B C D represent machines which are combined electro-dynamic motors and dynamo-electric generators. Each machine has a cylindrical or annular armature-core wound with two sets of continuous coils connected to two independent bar-commutators, *a b*. The smaller commutator *a* is the motor-commutator, and the brushes resting upon it are connected with the conductors of the main circuit 1 2, while the larger commutator, *b*, is that of the generating-coils, and the brushes bearing on it have conductors connected with them, with which lamps or other translating devices, E, are connected in multiple arc. These conductors of the three machines are represented by 5 and 6, 7 and 8, and 9 and 10. The field-circuits 11 12 of the combined motors and generators are

multiple-arc circuits from 1 2; or each machine may supply its own field from the current generated by it. In Fig. 2 the two sets of coils of each machine are shown. The inner or motor coils, *c*, are connected with the commutator *a*, while the outer or generating coils, *d*, are connected with the commutator *b*. Each of the combined motors and generators can be regulated independently of all others to give the desired tension of current in the translation-circuit supplied by it as a generator. This can be done by adjusting the brushes on either commutator or by varying primarily the strength of the field-magnet.

A shunt-circuit (not shown) may be formed around each machine B, C, and D, provided with a switch for making and breaking the same, so that any one of these machines can be cut out of circuit. If any machine were cut out of circuit, the electro-motive force at the source of supply would be reduced accordingly.

It will be understood, as before explained, that the independent windings of each combined machine are of the Siemens or Gramme pattern, while the field-magnet is common to both.

A continuous current is used to operate each machine, while the current generated by it is also continuous.

What I claim is—

1. The combination, with a main circuit having a current of high tension, of two or more combined electro-dynamic motors and dynamo-electric generators arranged in series as motors in such main circuit, and independent translation-circuits connected with the generating-coil of such machines and supplied thereby with currents of low tension, substantially as set forth.

2. The combination, with one or more dynamo or magneto electric machines supplying a main circuit with a current of high tension, of two or more combined electro-dynamic motors and dynamo-electric generators, each having two sets of armature-coils connected with two independent commutators, one set of commutator-brushes being in the line of the main circuit and the other set connected with conductors independent of the main circuit, and translating devices arranged in multiple-arc circuits from such independent conductors, substantially as set forth.

3. The combination, with the main circuit, having a current of high tension, of two or more combined electro-dynamic motors and dynamo-electric generators arranged in series as motors in the main circuit, and independent translation-circuits connected with the generating-coils of such machines and supplied thereby with currents of low tension, each of said combined machines being adapted for independent regulation, substantially as set forth.

4. The combination, with a main circuit, of two or more combined electro-dynamic motors and dynamo-electric generators arranged in series as motors in the main circuit, and independent translation-circuits supplied by such machines with currents of low tension, the coils of the field-magnet of each combined machine being in an independent circuit derived from the main circuit, substantially as set forth.

5. The combined electro-dynamic motor and dynamo-electric generator described, consisting of an armature having two independent continuous windings connected with separate bar-commutators, and a field magnet or magnets common to both windings, substantially as set forth.

This specification signed and witnessed this 22d day of May, 1882.

THOMAS A. EDISON.

Witnesses:
EDW. C. ROWLAND,
C. P. MOTT.

(No Model.)

T. A. EDISON.

TELEPHONE.

No. 266,021. Patented Oct. 17, 1882.

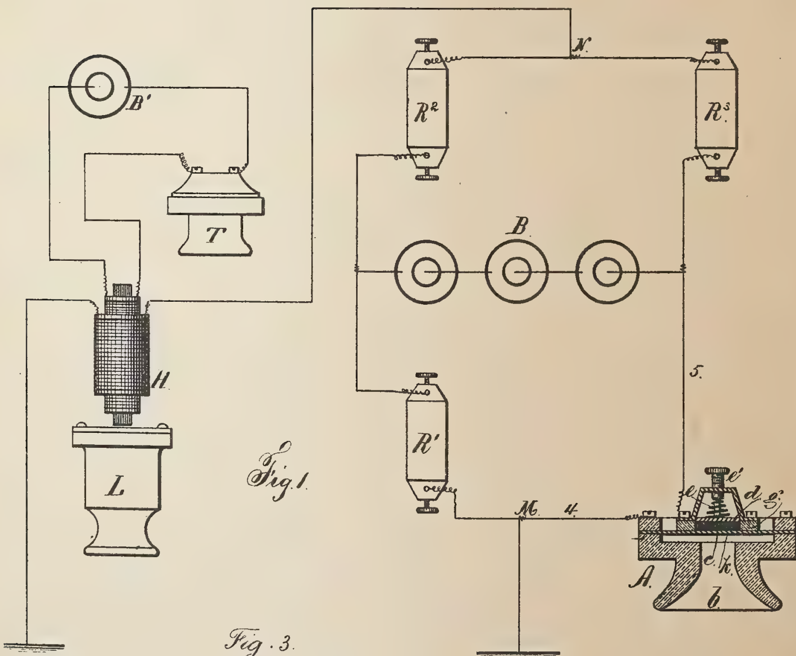
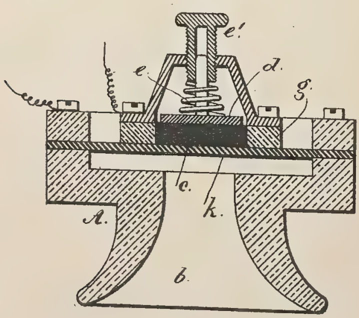


Fig. 1.

Fig. 3.



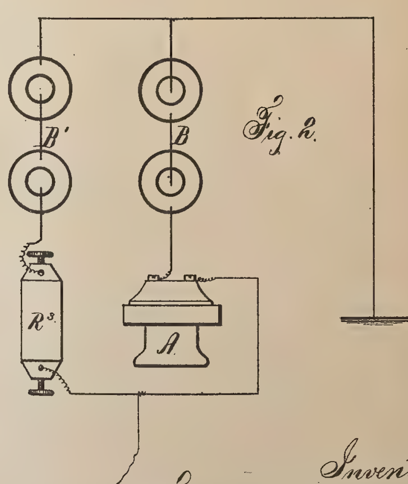


Fig. 2.

Case No. 158 A.

Witnesses
Harold Serrell
Chas H Smith

Inventor
per Thomas A Edison
Lemuel W. Serrell
atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 266,021, dated October 17, 1882.

Application filed October 17, 1881. (No model.) Patented in England June 15, 1878, No. 2,396.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Telephones, (Case No. 158A,) of which the following is a specification.

This application is a division of my application No. 158, filed November 11, 1878; and the said division is made for the purpose of separating from said original application matters that are not in interference, and for separating the different features of invention into two additional applications. The present I term "Case No. 158A." Letters Patent in Great Britain, No. 2,396, show the present device. The same was applied for June 15, 1878; but the specification was not filed until December 13, 1878.

The object of this invention is to transmit oral communications over electric circuits; and said invention consists in devices for transmitting positive and negative currents by varying the resistance in the telephonic transmitter, in combination with a Wheatstone balance.

The transmitting-instrument, containing carbon or similar material in the circuit, is also peculiarly constructed, and the diaphragm of the receiving-instrument is acted upon by an inductorium.

In the drawings, Figure 1 represents the transmitting-instrument sectionally, and also shows the circuit-connections by a diagram. Fig. 2 represents the circuit-connections in a slightly-modified form, and Fig. 3 is a section in larger size through the screw and circuit-regulator.

The transmitting-instrument A contains the mouth-piece *b* and a diaphragm, *k*, secured at its edges. The center of the diaphragm is platinized, and upon this rests a button, *c*, of finely-divided conducting material, such as metallized charcoal, lamp-black, or iodide of copper. The metallic plate *d* is kept in contact with the button by the spring *e*, and *e'* is an adjusting-screw to regulate the pressure of the spring against the plate *d* and button *c*. Said screw passes through the metallic support that is secured to the vulcanite ring *g* around the button *c*. The rod that is attached to the plate *d* passes freely into an axial hole in the screw *e'*, so as to be guided thereby, but allow the screw to be set up to regulate the spring without the screw acting directly on the plate *d*. The diaphragm is connected to the wire 4 and the plate *d* to the wire 5. The button, of carbon or other similar material, becomes a circuit-regulating device to control the electric condition of the line and cause the same to vary in a manner corresponding to the sound-waves that act upon the diaphragm, as set forth in applications heretofore made by me. The ring *g* and circuit-regulating devices are upon the diaphragm *k*, and hence move with it; but any atmospheric vibrations acting on the diaphragm *k* produce a variation in the resistance of the carbon or similar button, *c*, in the electric circuit, in consequence of the difference in pressure upon such carbon button, resulting from the tremulous movement of the parts and the inertia of the plate *d*. The carbon or similar material and the metallic surfaces in contact therewith become the electrodes of the electric circuit. The transmitter A is in one branch of the Wheatstone bridge, R^3 being a resistance equal to that of A when not subjected to sonorous vibrations. R' and R^2 form the other sides of the balance and have equal resistances. The bridge-wire from M to N is contained in the electric circuit that extends from N by the line-wire to the distant receiver H, thence to the earth, and returning to the earth-plate at the transmitting-station and to M. The battery B, of several cells, is between 5 and R' R^2. When the resistance of A R^2 is equal to that of R' R^3 no current circulates upon the line. When sonorous vibrations vary the resistance of the carbon button *c* in A the current will pass upon the line in one direction or the other. When the resistance of A is increased the current passes in one direction. When it is lessened the current passes in the other direction in consequence of the balance being disturbed. The induction-coil H has its secondary coil included in the line-circuit, and the primary coil is connected with a transmitting-instrument, T, constructed and operating in a similar manner to the transmitter A, the local battery B' being in the circuit through the carbon button and primary coil. The receiving-instrument L is provided with a diaphragm,

that is acted upon by the core of the induction-coil H, and hence the induction-coil is utilized, and serves for receiving or transmitting telephonically.

In Fig. 2 the balance of the similar batteries, B B′, with opposite poles to line, is obtained by the rheostat R^3, that is of a resistance equal to that of the instrument A when at rest, and when the resistance of the carbon button in A is increased or decreased by the sonorous vibrations the current will pass upon the line, either positive or negative, according to the resistance in A.

In my application No. 130 the diaphragm is in direct contact with a surface of plumbago or similar material, and in my application No. 151, patented April 30, 1878, No. 203,016, a carbon button and a diaphragm are employed, and there is a metallic plate intervening and in direct contact with both the carbon and the diaphragm. It is therefore to be understood that these features do not form the subject of the present invention.

I claim as my invention—

1. The combination, in a telephone, of an induction-coil having primary and secondary circuit-connections, with a diaphragm adjacent to and acted upon by such induction-coil and transmitting-instruments in such circuits, substantially as specified.

2. In combination with a battery or batteries, a system of balanced circuits, a telephonic transmitter constituting a variable resistance in one of the balanced circuits, and a telephonic receiver in the bridge-wire of the balance, substantially as set forth.

3. The combination, in a telephone, of carbon or similar material, forming a circuit-regulator, a diaphragm, and a holder upon and entirely supported by the diaphragm, and arranged to resist the movement of the diaphragm and circuit-regulator, substantially as set forth.

4. In a speaking-telephone, the combination, with the diaphragm, of carbon or equivalent material in the electric circuit, and a spring or yielding presser to apply an initial pressure to the carbon, and means for supporting both the carbon and presser upon the diaphragm, substantially as set forth.

5. In a speaking-telephone, the combination, with the diaphragm, of carbon or similar material, a spring pressing upon the carbon, and means for adjusting the pressure and supports therefor upon the diaphragm, substantially as set forth.

Signed by me this 7th day of September, A. D. 1881.

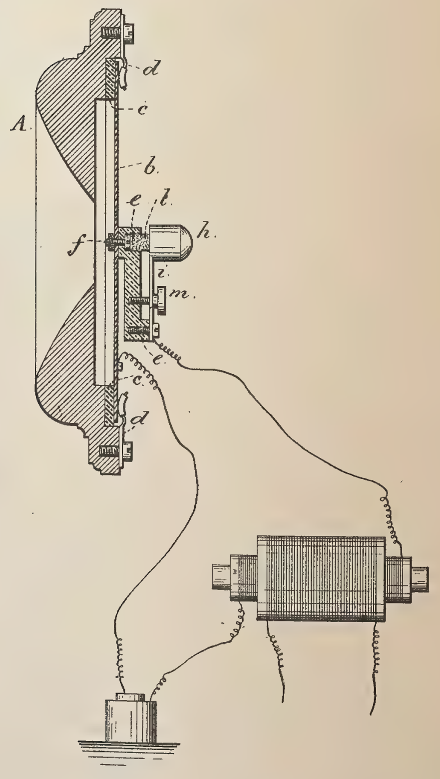
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.

TELEPHONE.

No. 266,022. Patented Oct. 17, 1882.



Witnesses:

J. Staib

Chas H. Smith

Inventor

Thomas A. Edison

per Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 266,022, dated October 17, 1882.

Application filed August 6, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Telephones, (Case No. 182,) of which the following is a specification.

This invention relates to the transmitting-instrument, and the same is an improvement on the device described and shown in an application for patent filed by me November 1, 1878, (Case 158.)

In the drawing I have shown a section of the transmitting-instrument. The mouth-piece is of usual character. At the back of said mouth-piece is the metal diaphragm *b*, and this rests upon a ring of india-rubber, *c*, and is held in place by spring-fingers *d*. The ends of these springs, where they press upon the diaphragm, are covered with rubber to prevent the grating sounds that there would be if the metal came in contact with the diaphragm as the latter is vibrated.

e is a block of insulating material, connected to the diaphragm by the screw and nut *f*. There is a circular recess in the block *e* for the head of the attaching-screw, and in this recess is placed a button or block, *l*, of finely-divided conducting material, such as plumbago.

h is a weight upon the spring-arm *i*, and the surface of this weight that is in contact with the plumbago is platinized.

It is to be understood that the carbon or similar material of inferior conducting-power is between the electrodes of the circuit, and the rise and fall of electric tension in that circuit results from greater or less intimacy of contact between the electrodes and the carbon due to the vibration of the diaphragm, as in my aforesaid application.

The initial pressure or intimacy of contact of *h* and *l* is regulated by the adjusting-screw *m*.

The operation of this tension-regulator is the same as of that set forth in aforesaid application, the atmospheric vibrations acting on the diaphragm *b*, producing a variation in the resistance of the carbon *l* in the electric circuit by the difference in pressure upon the carbon *l* resulting from the weight *h* acting by inertia as a resistance to the movement of the diaphragm.

In my application No. 178 I have shown a method of holding the diaphragm of a telephone by means of springs pressing against one of its surfaces, and also the combination, with the diaphragm of a telephone, of a band of yielding material around the same at or near the edge, and a dampening-finger, and in my application No. 158 I have shown a weight that acts by inertia as a resistance, causing the movement of the diaphragm to vary the pressure upon the carbon. Therefore these devices are not claimed herein.

I claim as my invention—

1. The combination, in a telephone, of a metallic diaphragm, an elastic ring forming a rest for the same, a spring-finger pressing the diaphragm to its rest, an arm connected with the diaphragm near the middle, carbon or similar material in a socket in said arm, and an adjustable spring carried by the arm to apply an initial pressure to such carbon and the electric circuit including the carbon, substantially as set forth.

2. In a telephone, the combination, with the diaphragm, of an arm attached at one end to the diaphragm, a spring attached at the other end of such arm, carbon or similar material between the spring and arm, a screw passing through the spring to adjust the initial pressure on the carbon, and a weight carried by the spring to act by inertia, substantially as set forth.

3. In a telephone-instrument, a loose diaphragm, an elastic ring forming a rest for the same, and one or more spring-fingers to hold the diaphragm to its seat and yielding material between the diaphragm and fingers, substantially as set forth.

Signed by me this 1st day of August, 1879.

THOS. A. EDISON.

Witnesses:

S. L. GRIFFIN,

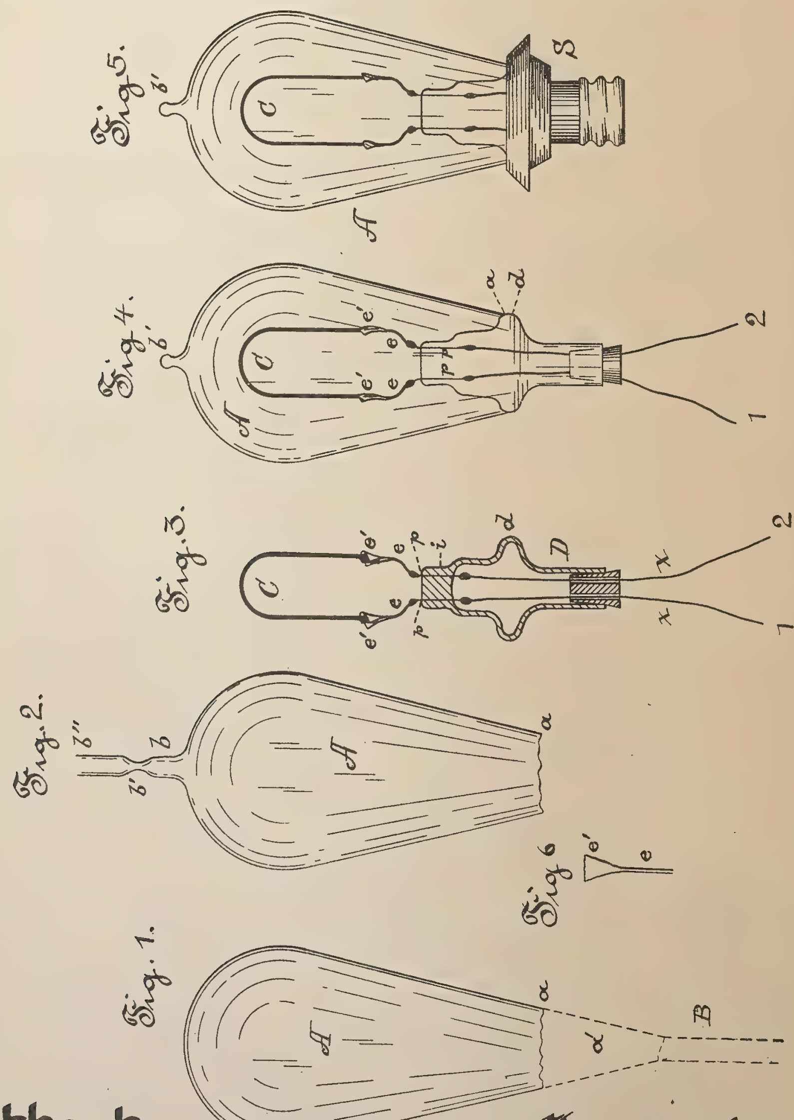
FRANK MCLAUGHLIN.

(No Model.)

T. A. EDISON.

ELECTRIC INCANDESCENT LAMP.

No. 266,447. Patented Oct. 24, 1882.



Attest:

D. D. Mott

H.W. Seely.

Inventor:

T. A. Edison

per

Dyer and Wilber

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC INCANDESCENT LAMP.

SPECIFICATION forming part of Letters Patent No. 266,447, dated October 24, 1882.

Application filed April 26, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Electric Incandescent Lamp, (Case No. 306;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The electric lamp used in my system consists essentially of a filamentary incandescing conductor of high resistance hermetically sealed in a glass vacuum-chamber.

In Letters Patent of the United States No. 230,255, granted to me, is shown and described a method or process of forming such a lamp. In this present case one object of the invention is to show and describe another method of forming such a lamp, while a second object is to furnish an efficient leading-in wire having a clamping device formed integral with it, as more fully hereinafter described and claimed.

In carrying the improved method referred to into practice the glass chamber is to be blown directly from the pot-glass. The blower takes upon the blowing-rod a sufficient quantity and blows the same into a bulb, giving it just sufficient motion to cause the bulb to slightly elongate, so that its outer extremity shall be or about be semicircular, from which the sides taper gradually in straight or nearly straight or slightly curved lines to the end of the blowing-rod. The bulb so formed is then broken away at the tapered end sufficiently to leave an aperture large enough for the introduction therethrough into the bulb of the carbon and its supports. Upon the semicircular end of the bulb a small opening is made, and a tube is formed thereon either by drawing out the material thereat or by attaching thereto a separate piece of tubing to form the exhaust-tube of the completed lamp for attachment to the exhaust apparatus. A small piece of tubing is taken and an enlargement blown or formed therein of a diameter about equal to that of the aperture referred to as being made in the tapering or conical end of the bulb. The leading-in wires—*i. e.*, the wires which pass into the lamp and are to connect with the carbon—are then laid in this tube, one end thereof being then brought to a nearly melting or welding heat and clamped down by suitable means upon the wires, hermetically and firmly sealing them in the glass of tube. The wires which are preferably used are each in three sections—viz., a central bit of platinum for sealing into the mass of the glass with copper extremities, one leading away from the lamp, and one into the lamp for receiving and supporting the carbon. This latter section may be cut from flat or sheet copper, with an enlarged end, or it may be formed of a bit of wire one of whose ends is flattened out. This enlarged flattened portion is wrapped around or folded upon the enlarged end of the carbon, securing it and making electrical contact therewith. This union may, if desired, be electroplated. The carbon being secured to the leading-in wires and then sealed in the tube referred to, the carbon is introduced into the bulb and the edge of the opening in the bulb and the enlarged portion of the tube sealed together at a welding heat. The lamp is then attached to the exhaust or vacuum apparatus by the exhaust-tube and the air exhausted therefrom. When the proper degree of exhaustion has been attained the lamp is sealed off by a welding and fusion of the exhaust-tube near to the body of the bulb or lamp. This may be better understood by reference to the drawings, in which—

Figure 1 shows the bulb as blown and attached to the blowing-rod; Fig. 2, the bulb with its end broken off and the exhaust-tube attached to the bulb; Fig. 3, the supporting-tube; Fig. 4, the lamp completed and sealed; Fig. 5, the lamp provided with means of attachment to a fixture; Fig. 6, a wire or blank for supporting the carbon.

The blowing-rod B, indicated in broken lines, is dipped into the molten or pot glass and a quantity sufficient for one bulb taken up thereon, which is then blown into the shape shown in Fig. 1. This shape is semicircular at its outer end, from whence the sides taper in straight or nearly straight lines to the smaller end, and this shape distinguishes the electric lamp bulb or globe thus made from any heretofore made. The part a' is then cut

or broken from the body of A, leaving an aperture at *a*. A is then heated at *b*, and a tube, *b''*, formed thereon either by drawing out the material at *b* or by attaching thereto a separate piece of tubing. A piece of tubing, D, is taken and an enlargement, *d*, formed thereon of about the diameter or of a slightly larger diameter than *a*. In this tube D are laid the leading-in wires 1 2. These wires are each formed of three sections—a central one, *p*, of platinum, which is the portion to be in contact with the glass, with outer sections, *e x*, of copper. The end *i* of the tube is then brought to a welding heat and squeezed firmly together, sealing the parts *p p* of 1 2 firmly and hermetically therein. The carbon C is then attached to the wire sections *e e*. One of these wires is shown in Fig. 6. They may be cut of the shape there shown from flat copper; but I prefer to take a piece of wire, *e*, and flatten its end to form the enlargement *e'*, which enlargement is folded upon or wrapped around one enlarged end of the carbon, making a firm and secure contact therewith and support therefor. If desired, this union may then be plated. If desired, the neck or tube D may be made as the patent referred to, and the wires and clamps therein shown used; but for economy I prefer the means and methods herein shown. The tube and carbon being arranged in relation to each other, as shown in Fig. 3, the carbon is introduced within the body of A and the edges *a* and *d* brought to a welding heat and sealed together. The lamp is then attached by the exhaust-tube *b''* to the vacuum apparatus, and when the proper degree of vacuum has been reached it is sealed off at *b'*, the result being the lamp shown in Fig. 4. Means S for attaching the lamp to its support or fixture are then secured thereto, and the lamp is ready for the market.

What I claim is—

1. The method of manufacturing incandescent electric lamps, substantially as set forth, consisting in forming the inclosing bulb or globe directly from molten or pot glass, forming separately the supporting tube or neck for the incandescent conductor, sealing therein the leading-in wires, attaching the carbon thereto, and then hermetically uniting the parts by a welding together prior to the exhaustion of the lamp, substantially as set forth.

2. A leading-in wire composed of a central platinum section for sealing into the glass an outer section and an inner section, having a clamping device formed integral therewith, substantially as set forth.

This specification signed and witnessed this 21st day of April, 1881.

THOS. A. EDISON.

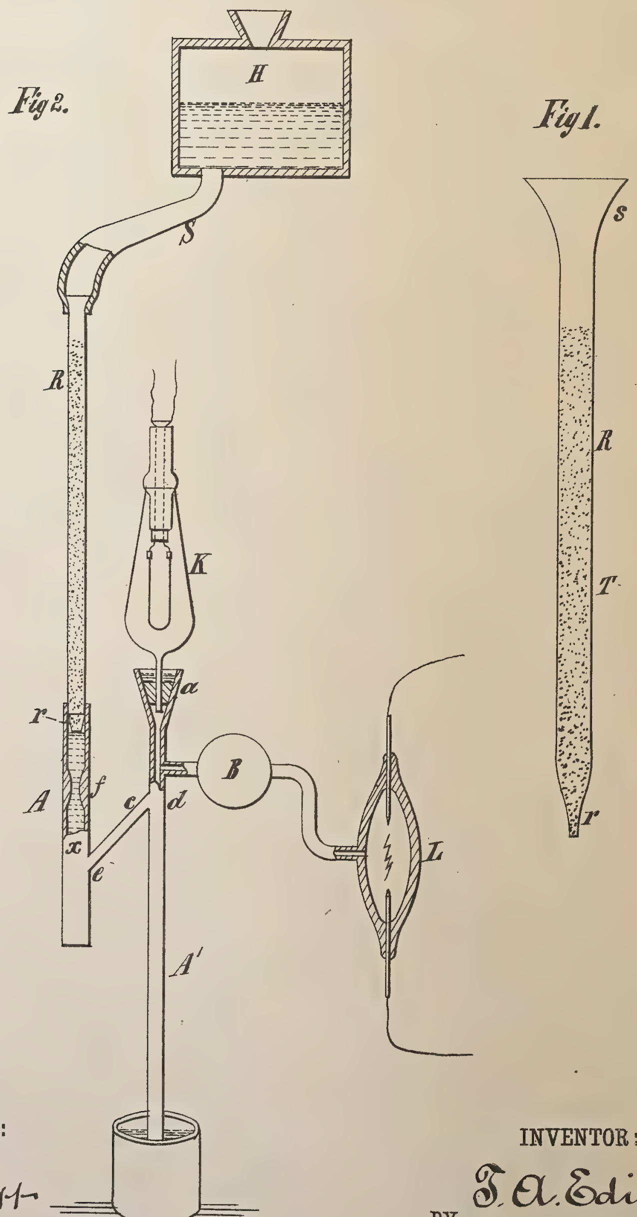
Witnesses:
WM. H. ALDEN, Jr.,
H. W. SEELY.

(No Model.)

T. A. EDISON.

VACUUM APPARATUS.

No. 266,588. Patented Oct. 24, 1882.



WITNESSES:

D. W. Mott

J. Ellis Clark

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

VACUUM APPARATUS.

SPECIFICATION forming part of Letters Patent No. 266,588, dated October 24, 1882.

Application filed December 6, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Vacuum Apparatus, (Case 364;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In the continued use of mercury in vacuum apparatus it is liable to become more or less foul and dirty, while it is essential for the most perfect and rapid operation of such apparatus that the mercury should be clean and bright. The object, therefore, I have in view is to produce a method and means for cleaning the mercury. This I accomplish by filtering the mercury through finely broken or crushed glass. I find that the best effect is obtained by retarding the flow of the mercury through the glass, this being readily accomplished by making the outlet small enough for the purpose. In practice I prefer to employ a glass tube having its lower end drawn out into a smaller or capillary tube, which retards the flow of the mercury. The body of the tube is filled with finely broken or crushed glass. This filtering-tube may be used alone independent of the vacuum apparatus, or it may be attached to and form a portion of the same, the mercury passing through the filter before reaching the drop-tube of the vacuum apparatus. This is a very convenient form for the filter, since the mercury is cleaned each time it passes through the vacuum apparatus.

The foregoing will be better understood from the drawings, in which Figure 1 is a view of the mercury-filter separate from the vacuum apparatus, and Fig. 2 a view showing the filter forming a part of the vacuum apparatus.

In Fig. 1, R is the glass tube drawn out into a capillary tube at its lower end, *r*. Its upper end, *s*, may, for convenience, be given a funnel shape. This tube is filled partially or wholly with glass broken or crushed quite fine, as indicated by T.

In Fig. 2 the filter R, with reduced lower end, *r*, is shown as placed between the elevated mercury-reservoir H and first drop-tube, A, of a Sprengel pump. The mercury on its course from the reservoir to the drop-tube is forced to pass through the filter.

What I claim is—

1. The mercury-filter consisting of a tube or vessel with a contracted or capillary exit and containing broken or crushed glass, substantially as set forth.

2. The combination, with mercurial vacuum apparatus, of a filter for cleaning the mercury, located between the elevated mercury-reservoir and the point of exhaustion, substantially as set forth.

3. The combination, with a Sprengel or drop pump, of a filtering-tube containing broken or crushed glass and having a contracted exit, said filtering-tube being located between the elevated mercury-reservoir and the drop-tube of the pump, substantially as set forth.

This specification signed and witnessed this 25th day of November, 1881.

T. A. EDISON.

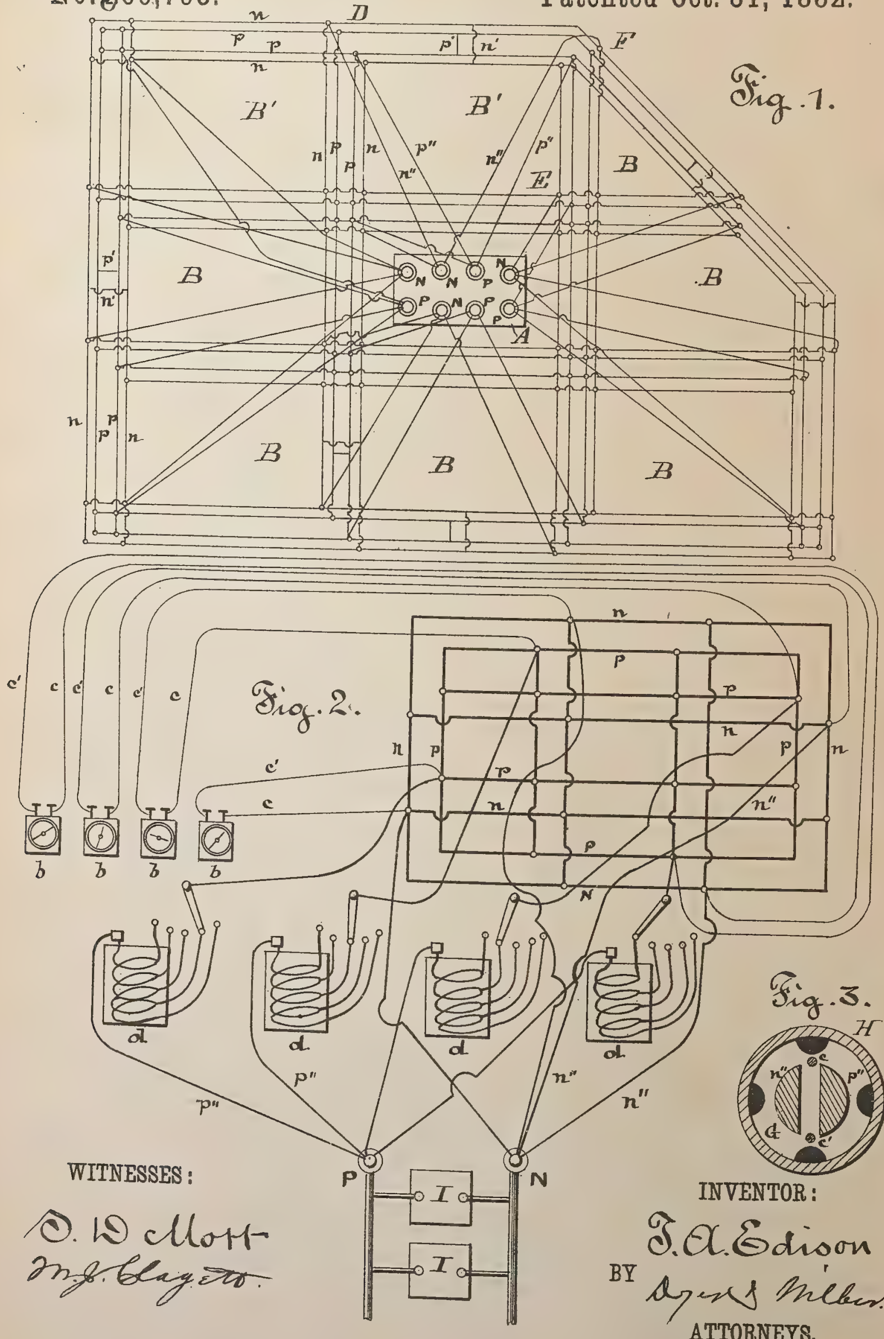
Witnesses:
RICHD. N. DYER,
WM. H. MEADOWCROFT.

(No Model.)

T. A. EDISON.

ELECTRIC DISTRIBUTION SYSTEM.

No. 266,793. Patented Oct. 31, 1882.



WITNESSES:

D. W. Mott

M. J. Clayton

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

United States Patent Office

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC DISTRIBUTION SYSTEM.

SPECIFICATION forming part of Letters Patent No. 266,793, dated October 31, 1882.

Application filed December 9, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Distribution Systems, (Case No. 361;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In a system of electric lighting in which a town or village or a portion thereof is supplied from one central station it may sometimes occur that the district supplied is irregular in shape, and that in some parts of the district more lights may be used, and consequently more electricity required, than in others.

The object of this invention is to so arrange the system of conductors supplying the district that the supply in the various localities of the district will be proportioned to the demand.

In a prior application I have set forth the manner in which I usually prefer to arrange my conductors in cases where about the same supply is required all over the district, viz: Along each face of each block in the district are laid two conductors—one "positive," the other "negative"—and at every street-corner where the conductors intersect each other all the positive conductors are connected together and all the negative—that is, wherever two conductors of the same name cross each other they are connected together—and feeding-conductors connect with these street-mains at certain definite and regularly-arranged points, so that a constant amount of electricity is supplied in all parts of the district in a uniform manner; but where, as explained above, the district is irregular in shape and some parts of it require more current than others this arrangement is modified as follows: By estimating the number of lamps or other translating devices used in the entire district and the proportion used in various parts thereof, I am enabled to discover what may be termed the "centers of consumption"—that is, the points in the neighborhood of which or around which a certain amount of electricity is consumed.

In parts of the district which are thickly settled and contain a good many consumers of electricity the center of consumption would be the center of a very small space, while in sparsely-inhabited localities, where few lamps are used, the space surrounding the center of consumption would be larger. The district might thus be considered as divided into irregularly-shaped sub-districts, each containing about the same number of lamps, and each consuming approximately the same amount of energy. To each of these centers of consumption is run from the central station a "feeding-circuit", consisting of a positive and a negative conductor, each of which is connected at the proper point to a similar conductor of the main system. As stated above, all the positive and all the negative main conductors are connected together wherever they intersect. I sometimes find it desirable to connect them also at other points by running cross-connections across the street at various places along the faces of the blocks.

The feeding-conductors are preferably of the form set forth in my prior application, (Serial No. 31,825,) with the exception that small additional wires are laid in the tubes, which form additional circuits, each of which runs from a center of consumption back to the central station, where it passes through an electro-dynamometer or other suitable device for indicating electric pressure, and thence returns again to the center of consumption, so that the amount of energy used in each feeding-circuit or the electrical potential at center of consumption is indicated, and adjustable resistances are placed in each feeding-circuit, so that according to the indications of the electro-dynamometer more or less current may be supplied to the circuit. The main conductors of the consumption-circuit are made of such size that the drop in electro-motive force upon them will not be sufficient to vary practically the candle-power of the lamps, while upon the feeding-conductors any drop may be provided for without affecting the relative candle-power of the lamps of the consumption-circuit, such feeding-conductors having no translating devices connected therewith. The loss upon the feeding-conductors is preferably greater than that upon the main conductors of the consumption-circuit, but will be varied in different lo-

calities according to the relative cost of copper for conducting purposes and horse-power for generation. The electro-dynamometer used is preferably that of Weber, a large resistance—say 10,000 ohms—being placed in circuit with the instrument, as is well understood, so that the instrument will vary with the variations in tension, and will practically indicate the electro-motive force of the current.

In the accompanying drawings, Figure 1 is a diagram of a district, showing the system of mains and feeding-circuits; Fig. 2, a diagram showing a part of the district, with a portion of the apparatus used at the central station; and Fig. 3 is a cross-section of one of the underground tubes containing the conductors of a feeding-circuit.

A, Fig. 1, represents a central station; N and P, respectively the negative and positive poles of batteries of electric generators situated in the station. B B′ B″ are blocks which compose the district or part of it. The blocks B′ B″ may be taken as types of all the others. In each of the streets surrounding these blocks are laid the main conductors *p n*, *p* representing positive and *n* negative conductors.

Wherever conductors of the same name cross each other they are run into a junction-box and connected, and additional connections may also be made between them by cross-conductors *n′ p′*, placed across the street at various points along the faces of the blocks.

The centers of consumption are, as before explained, various irregularly-located points at different distances from the source of supply, A, such as the points C D E F. To these points are run the feeding-circuits, each consisting of a positive conductor, *p″*, and a negative conductor, *n″*. The conductors *p″* all run from positive poles P of the generators and the conductors *n″* from negative poles N. By these feeding-circuits electricity is supplied to the different groups of lamps, each of which surrounds a center of consumption.

In Fig. 3, *n″ p″* are the feeding-conductors, surrounded by insulating-washer G, which separates them from an inclosing metal tube, H. *c c′* are small wires, which also pass through the tube H.

Fig. 2 illustrates the manner in which the conductors surrounding any block B of the district are arranged.

I I represent a battery of electric generators, N P being respectively its negative and positive poles, from which run the feeding-conductors *n″ p″* to the centers of consumption of the block, where they are connected to the street-conductors *n p* by means of the junction-boxes described in a prior application.

For convenience in the drawings, the wires *c c′*, which are inclosed in the same tube with the conductors *n″ p″*, are shown separated from these conductors in Fig. 2. These wires *c c′* form an auxiliary circuit to each feeding-circuit, passing through electro-dynamometers *b b* or other suitable devices for indicating electric pressure at the central station, which by this means indicate the electrical potential at the centers of consumption.

d d are adjustable resistances, placed in the feeding-circuits, by means of which more or less current may be made to pass through such circuits, according to the indications of the electro-dynamometers.

What I claim as my invention is—

1. In a system of electrical distribution, the intersecting and connected positive conductors and the intersecting and connected negative conductors, forming the main conductors of the consumption-circuit, upon which the drop in electro-motive force is not sufficient to vary practically the candle-power of the lamps, in combination with a central station and feeding-conductors having no translating devices connected therewith, and extending from the source of electrical energy at the central station to the main conductors of the consumption-circuit, said feeding-conductors being connected with such main conductors of the consumption-circuit at or near centers of consumption, substantially as set forth.

2. The combination, with a feeding-circuit of an electrical distribution system, of an auxiliary circuit composed of smaller conductors connected at its terminals with the terminals of the feeding-circuit, and containing a suitable device for indicating electric tension, so that the electro-motive force of the current in the main circuit is indicated, substantially as set forth.

3. The combination of the conductors forming a circuit of an electrical distribution system, placed in an inclosing tube, of smaller conductors in the same tube, having their terminals connected with those of the main conductors, and forming a circuit in which is placed a suitable device for indicating electric tension, substantially as and for the purpose set forth.

4. In a system of electrical distribution, the combination of the intersecting and connected positive conductors and the intersecting and connected negative conductors, forming the main conductors of the consumption-circuit, with cross-connections connecting the conductors of the same polarity together between the points of intersection, a central station, and feeding-conductors having no translating devices connected therewith, and extending from the source of electrical energy at the central station to the main conductors of the consumption-circuit at or near centers of consumption, substantially as set forth.

5. In a system of electrical distribution, the intersecting and connected positive conductors and the intersecting and connected negative conductors, forming the main conductors of the consumption-circuit, in combination with a central station, feeding-conductors extending from the central station to the consumption-circuit, and having no translating devices connected therewith, and means located in

each feeding-circuit for regulating the tension of the current supplied thereby to the consumption-circuit, substantially as set forth.

6. In a system of electrical distribution, the intersecting and connected positive conductors and the intersecting and connected negative conductors, forming the main conductors of the consumption-circuit, in combination with a central station, feeding conductors extending from the central station to the consumption-circuit, and having no translating devices connected therewith, an auxiliary circuit extending to the outer end of each feeding-circuit and containing a device for indicating electro-motive force, and an adjustable resistance in each feeding-circuit, substantially as set forth.

This specification signed and witnessed this 25th day of October, 1881.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
RICHD. N. DYER.

(No Model.)

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 268,205. Patented Nov. 28, 1882.

Fig. 1.

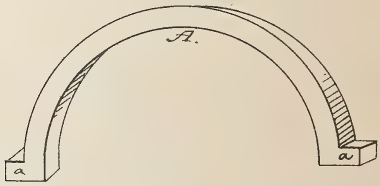


Fig. 2.

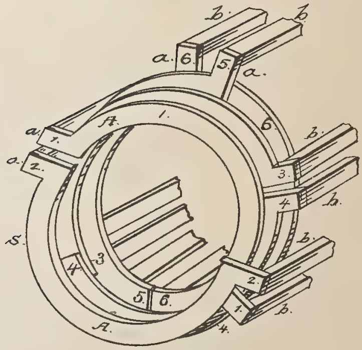


Fig. 3.

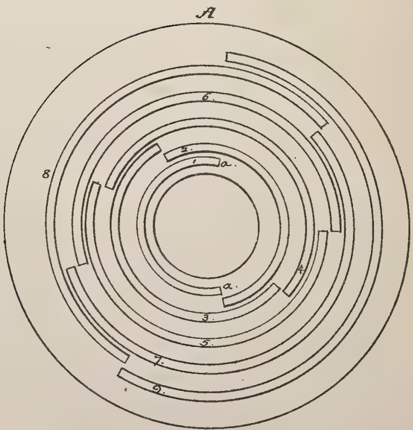
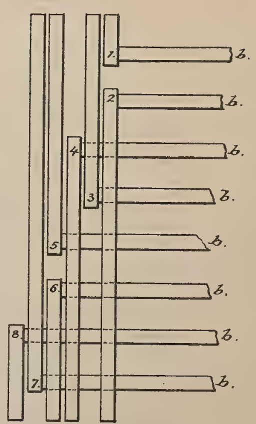


Fig. 4.



Attest;
F. W. Howard
R. B. Wilber

Inventor;
T. A. Edison per
Z. F. Wilber Atty.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 268,205, dated November 28, 1882.

Application filed May 17, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 416;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In that class of magneto or dynamo electric machines in which the revolving armature is composed of a cylindrical core whose surface is partially or entirely covered with coils wound parallel to the axis of the armature the coils cross each other at the ends, so that there is a large mass of wire upon the ends useless for the purposes of generation, while interposing unnecessary internal resistance in the machine, and at the same time being in position for excessive accumulation of heat. These masses of wire, crossing each other at the ends, render repairs to any coil exceedingly difficult, for the repair of any one coil involves the unwinding of such coils as may overlap it upon the ends. A plan for remedying these defects forms the subject-matter of United States Letters Patent No. 242,898, granted me June 14, 1881. In that invention the end crossings of wire upon the armature were replaced by radial metal plates, appropriate radial plates being connected in couples or pairs by circular metallic conductors.

The object of the invention in this case is to still further simplify the construction of the armature, and it is in substance an improvement upon the patent noted.

It consists in such construction and arrangement of the circular joining-conductors that the radial plates may be dispensed with and the connection of proper inductive portions into pairs or loops be made by the circular joining-conductors themselves. This is illustrated in the accompanying drawings, in which—

Figure 1 is a view of a single circular joining-conductor; Fig. 2, a perspective showing the arrangement of the circular joining-conductors and inductive bars, strips, or wires; Fig. 3, a diagrammatic plan; and Fig. 4, a side view, showing the relative arrangement of the circular joining-conductors to each other.

Figs. 2, 3, and 4 represent the non-commutating end of the armature, and A, in full lines in Fig. 1, one of the circular joining-conductors. As in the case of the patent noted, these circular joining-conductors are a little more than half a circle, (or, if an oval or other shape be used, of little more than half its circumference,) and are provided with lugs *a a*. The requirement as to shape or form is simply that they be of such shape or form as to readily pass around the central shaft or axis of the armature. They may be formed of bars similar in size to the inductive portion of the armature, or they may be made of flat strips. They are secured upon an insulating-base upon the end of the armature-core, one upon the other, and are also effectually insulated from each other, and they are arranged so that the members of each pair overlap at one end and do not meet at the other, and, taking any point as the initial point, they alternately overlap and alternately do not quite meet. In Fig. 2, for instance, starting at S and going to the right, 1 2 do not quite meet, 5 6 overlap, 3 4 do not meet, 1 2 overlap, 5 6 do not meet, and 3 4 overlap. This probably is more apparent in Fig. 3, where nine are shown; but it is to be remembered that preferably the circular joining-conductors are to be placed one upon the other instead of concentrically. To the lugs *a a* are secured the inductive parts *b b b*—bars in this instance—the overlapping at one end and the non-meeting at the other of a pair of joining-conductors insuring the union into a pair, loop, or couple by each joining-conductor of opposite inductive portions, while at the same time uniformity in the distribution of the mass of the joining-conductors is secured, as upon every part of the end there is an equal thickness of metal, as may readily be seen from inspection of Fig. 3. Upon the commutating end the lugs of the conducting-plates are joined to strips leading to the commutator, so as to form the connections shown in the patent noted, all the inductive portion being thereby retained in circuit. While the connecting-plates are shown as circular, it is evident that this mere shape may be varied, such a shape being retained as

will give a proper concavity for passing around the shaft.

What I claim is—

1. In a dynamo or magneto electric machine, an armature having its ends formed of strips or pieces connecting the inductive portions into pairs or loops, and cut or shaped to pass partially around the axis of the armature, substantially as set forth.

2. In a magneto or dynamo electric machine, an armature having the strips or pieces connecting the inductive portions into pairs or loops piled upon but insulated from each other, each of said strips or pieces partially encircling the armature-shaft, substantially as set forth.

3. In the armature of a dynamo or magneto electric machine, the combination, with each loop or couple of the inductive portion, of a strip or piece formed or shaped to pass partially around the axis upon the end of the armature, substantially as set forth.

4. In the armature of a dynamo or magneto electric machine, the combination, with the inductive portions, of the cross connecting strips or pieces alternately overlapping and not meeting, substantially as set forth.

This specification signed and witnessed this 1st day of May, 1882.

THOMAS A. EDISON.

Witnesses:

H. W. SEELY,

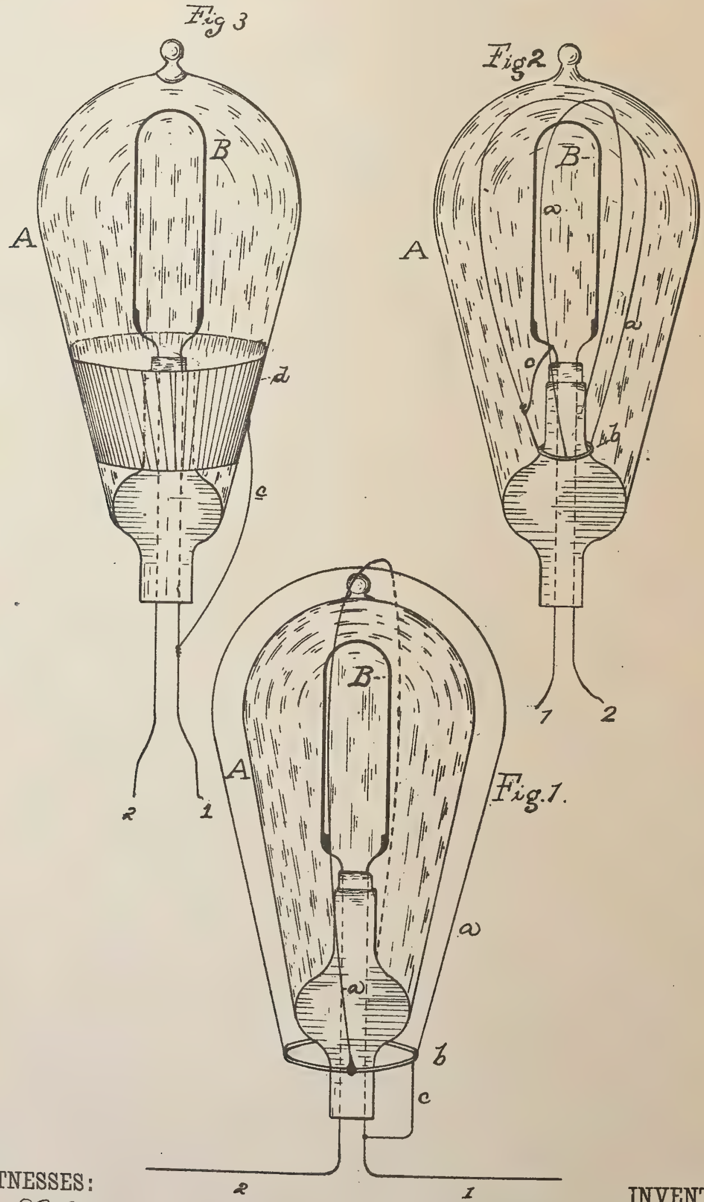
P. B. WILBER.

(No Model.)

T. A. EDISON.

INCANDESCING ELECTRIC LAMP.

No. 268,206. Patented Nov. 28, 1882.



WITNESSES:

Edw. C. Rowland

H W Seely

INVENTOR:

Thomas A. Edison

By Rich^d N. Dyer, Atty.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCING ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 268,206, dated November 28, 1882.

Application filed October 12, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Electric Lamps, (Case No. 479,) of which the following is a specification.

In the use of incandescing electric lamps in which a carbon filament is inclosed in a glass globe difficulty may sometimes be experienced, caused by the attraction of particles of carbon to the globe, which results in the gradual wearing away of the carbon, and in the blackening of the globe by the deposition of carbon particles thereon. The earth and the atmosphere which surrounds the lamp are charged with electricity opposite to that of the wires of the system and the carbon filament, and therefore the glass of the globe becomes charged with such opposite electricity, so that a static attraction exists between the carbon and the glass, and the heated carbon particles may be attracted by said glass.

The object of my invention is to avoid, as far as possible, such difficulty; and to this end I provide, in connection with a lamp, means for neutralizing, as far as possible, this static attraction. Such means consists of a body or bodies of metal or other conductor of electricity connected with one of the conductors leading to the carbon filament, and surrounding the globe, or situated at several different points around the globe, or placed within the globe and around the filament. Such metal, becoming charged with electricity of the opposite kind to that with which the glass is charged, neutralizes the static attraction and prevents the removal of the particles of carbon.

The preferred manner of carrying out my invention is to place over the lamp a wire cage consisting of two or more wires bent over the top of the lamp, with their lower ends all attached to a metal ring encircling the lower part of the lamp, a wire from said ring being connected to one of the conductors leading to the lamp; or such wire cage could be placed within the lamp with the wires bent over the filament, and attached to one of the leading-in wires of the lamp; or, instead of using the wire cage, a sheet of tin-foil may be wrapped around the outside of the lower part of the globe, and connected with one of the conductors with the same result.

Instead of metal wires, carbon or other conductor of electricity may be used.

In the drawings, Figure 1 represents that form of my invention in which the wire cage is placed outside the globe; Fig. 2, that in which said cage is placed within the globe, and Fig. 3 that in which the tin-foil is wrapped around the lower part of the globe.

A is the inclosing glass globe, and B the carbon filament. 1 and 2 are the conductors leading to the lamp.

In Fig. 1 a metal ring, *b*, preferably nickel-plated, encircles the lower part of the lamp, and is connected by a wire, *c*, with conductor 1, and nickel-plated wires *a a*, attached to said ring, are bent over the top of the globe. In Fig. 2 the wires *a a* are attached to the ring *b* within the globe, and wire *c* runs to one of the leading-in wires of the lamp. In Fig. 3 a piece of tin-foil, *d*, is wrapped around the globe below the filament, so as not to obscure the light, and wire *c* runs from the tin-foil to the conductor 1.

It is evident that the connection by wire *c* may be made with either of the leading-in wires of the lamp.

What I claim is—

1. The combination, with the inclosing globe and carbon filament of an incandescing electric lamp, of means for neutralizing the static attraction between the carbon and globe, substantially as set forth.

2. The combination, with the inclosing globe and the carbon filament of an incandescing electric lamp, of a body or bodies of metal surrounding said filament, or placed at different points around said filament, and connected to one of the conductors leading to said filament, substantially as and for the purpose set forth.

3. The combination, with the carbon filament of an incandescing electric lamp, of a wire cage

placed over and around said filament, and connected with one of the wires leading to said filament, substantially as set forth.

4. The combination, with an incandescing electric lamp, of a metal ring encircling the lower part of said lamp, and connected to one of the conductors leading to the lamp, and two or more wires bent over the top of the lamp, with their ends attached to said ring, substantially as set forth.

This specification signed and witnessed this 10th day of October, 1882.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

E. H. PYATT.

(No Model.)

T. A. EDISON.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

No. 271,613. Patented Feb. 6, 1883.

Fig. 1.

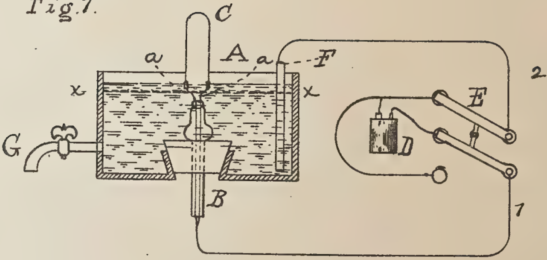


Fig. 2.

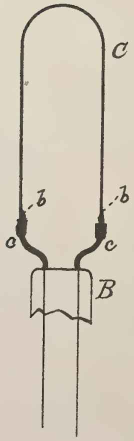
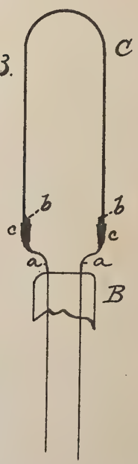


Fig. 3.



WITNESSES:

Edw. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Richd. N. Dyer Atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 271,613, dated February 6, 1883.

Application filed September 13, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescing Lamps, (Case No. 478,) of which the following is a specification.

In my incandescing electric lamps the carbon incandescing conductor is attached to the wires which convey the current thereto by the electro-deposition of metal at the points of union.

In carrying out this process the interior stem or tube of the lamp having the wires sealed in it and the carbon temporarily attached by any ordinary mechanical means to said wires is placed in an electro-depositing cell, together with a copper plate forming the anode, and copper is deposited on such wires and the ends of the carbon, forming a secure joint.

Heretofore I have placed the tube in the lamp with the wires covered with copper over the entire length above the glass. I have, however, found it desirable to have as little metal as possible inside the lamp, so that the gases and vapors occluded in such metal may be more readily and completely removed during the process of exhaustion.

The object of this invention, therefore, is to produce a lamp which shall have only a small amount of electro-deposited metal, just enough to complete the joint, placed only upon the ends of the leading-in wires. I accomplish this by placing the glass wire-support in the electro-depositing cell upright, and with the top of the liquid in the cell a little below the upper edges of the enlarged ends of the carbon. A suitable copper anode is provided, the wires and carbon forming the cathode. Copper is deposited as usual over the entire length of the wires above the glass. After this a portion of the solution is removed from the vessel by means of a faucet provided for that purpose until the liquid falls to a little below the enlarged ends. The current through the cell is then reversed, the wires becoming the anode and the copper plate the cathode, when the metal is removed from said wires and deposited on said plate, leaving only that which forms the union between the carbon and wires. Instead of removing a portion of the liquid from the cell, the stopper in the bottom of the cell which holds the glass-support (as described in my Patent No. 248,436) may be pushed up farther, so as to raise the proper portion of the wires out of the liquid.

In the drawings, Figure 1 is a view of the apparatus employed in my invention; Fig. 2, a view of the carbon and wires as they appear after the first stage of the process, and Fig. 3 a view of the same when completed and ready to be placed in the lamp.

A is the electro-depositing cell; B, the glass wire-support; *a a*, the leading-in wires, and C the carbon, having enlarged ends *b b*. D is a battery, and E a circuit-reverser, from which wires 1 2 run respectively to the leading-in wires *a a* and to the anode F of the cell. The liquid is originally of the height shown, but is afterward removed by the faucet G, as set forth, to the level of the dotted line *x x*. In Fig. 2 the wires *a a* are entirely covered with electro-deposited copper *c*, while in Fig. 3 there is only enough copper, *c*, left on the wires and carbon to make a proper joint.

What I claim is—

1. The method of forming an electroplated joint between the wires and carbon in an incandescing electric lamp, consisting in first depositing metal upon the ends of the carbon and the entire length of the wires above the glass, and then removing said metal from the lower parts of said wires, substantially as set forth.

2. The method of forming an electroplated joint between the wires and carbon in an incandescing electric lamp, consisting in first depositing metal upon the ends of the carbon and the entire length of the wires above the glass, then changing the relative level of the electrolytic liquid, so as to leave a small portion of the wires above said liquid, and then reversing the current through the cell, substantially as set forth.

3. The method of forming an electroplated joint between the wires and carbon in an incandescing electric lamp, consisting in first depositing metal upon the ends of the carbon and the entire length of the wires above the glass, then removing a portion of the liquid from the electro-depositing cell, and then re-

versing the current through the cell, substantially as set forth.

4. The combination of an electro-depositing cell, a copper plate, and the carbon and leading-in wires of an incandescing lamp, forming the electrodes of the cell, means for changing the level of the liquid in the cell relative to such wires and carbon, and means for changing the direction of the current through the cell, substantially as set forth.

This specification signed and witnessed this 25th day of August, 1882.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

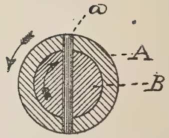
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

SHAFTING.

No. 271,614. Patented Feb. 6, 1883.



ATTEST:

Edw. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Richd. N. Dyer.

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SHAFTING.

SPECIFICATION forming part of Letters Patent No. 271,614, dated February 6, 1883.

Application filed October 20, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Shafting, (Case No. 502,) of which the following is a specification.

The object I have in view is to produce shafting in which the torsional elasticity will be reduced to the minimum or destroyed altogether. This I accomplish by constructing a shaft in two parts, one being placed within the other. These parts are proportioned to have the desired strength, and relatively to have the same or nearly the same torsional elasticity. After being placed one within the other the two parts of the shaft are twisted in opposite directions, being strained up to the limits of their torsional elasticity, when they are secured together in any suitable way, so that they will react upon each other and balance the torsional elasticity, producing a rigid shaft. This may be done by drilling holes through the two parts of the shaft and driving pins through them, or by coupling the two parts of the shaft together at their ends. Both of these methods of securing the two parts together may, however, be combined.

In the accompanying drawing a cross-section of the non-torsional shafting is shown.

A and B are the two parts of the shaft, placed one within the other, the inner part, B, being either solid or of tubular form. The parts are twisted in opposite directions, as shown by the arrows, and strained to the limits of their torsional elasticity, when they are fastened together by pins a, or by other suitable means. The shaft may be constructed of iron, steel, or other suitable material. I have found this character of shafting exceedingly efficient for use in connecting the governors of several engines together, so as to force the engines to act in unison; but I do not wish to limit myself to any particular use, since it is applicable to all uses where non-torsional shafting would be advantageous.

What I claim is—

A non-torsional shaft constructed in two parts, strained torsionally in opposite directions and connected together permanently while under such torsional strain, substantially as set forth.

This specification signed and witnessed this 19th day of October, 1882.

THOS. A. EDISON.

Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

GOVERNOR FOR DYNAMO ELECTRIC MACHINES.

No. 271,615. Patented Feb. 6, 1883.

Fig. 1.

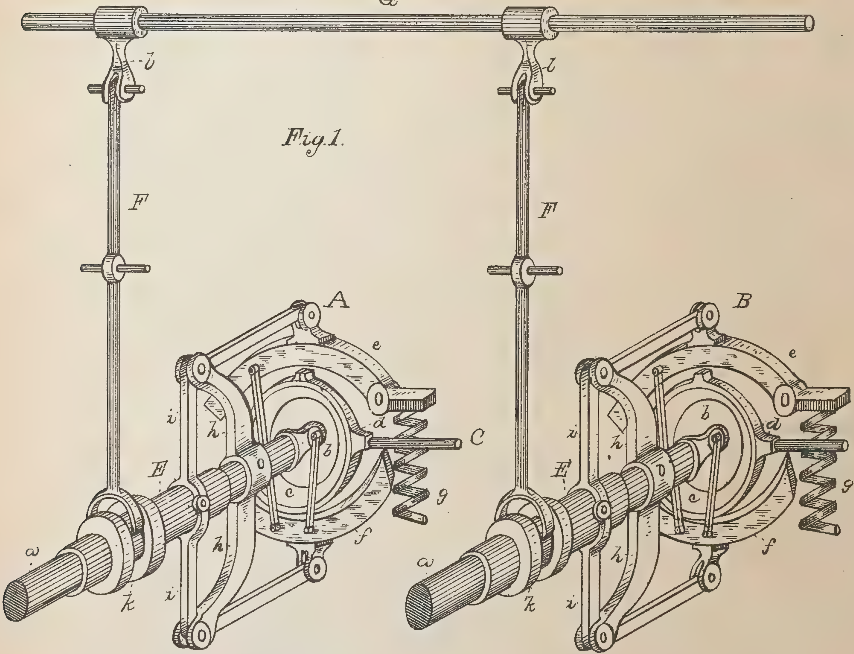
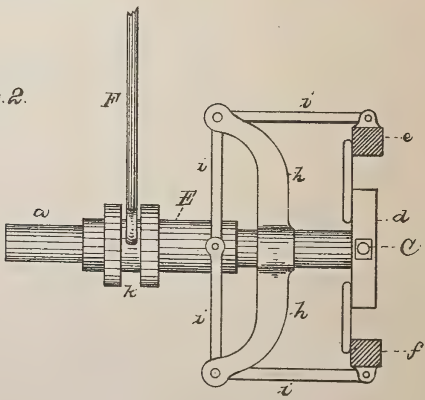


Fig. 2.



ATTEST:
E. C. Rowland
W. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer,
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

GOVERNOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 271,615, dated February 6, 1883.

Application filed November 9, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Governors for Dynamo-Electric Machines, (Case No. 501,) of which the following is a specification.

The object I have in view is to produce simple and efficient means for connecting together, so that they will work in unison, the automatic cut-off mechanisms of a number of engines, such cut-off mechanisms being composed of loose valve-eccentrics and wheel-governors adjusting such eccentrics. The invention is especially applicable to such engines when they are used to run dynamo or magneto electric machines feeding into the same conductors or system of conductors.

In my application No. 500 (Serial No. 75,203) I have shown and described means for connecting the cut-off mechanisms of engines of this character, my present invention relating to other means for accomplishing the same purpose.

In carrying out my invention I mount a sliding sleeve upon the shaft of each engine, and connect it by bell-cranks with the weights of the wheel-governor, so that the movement of such weights will give the sleeve a longitudinal sliding movement upon the engine-shaft. The sliding sleeves of the several engines being connected together, the cut-off mechanisms will be forced to work in unison. To make this connection each sleeve is provided with a grooved collar engaging the forked end of a pivoted lever, the pivoted levers of the several engines being removably connected with arms from a common shaft. This shaft moves only as the cut-off mechanisms are varied in unison by the combined action of the wheel-governors.

In the accompanying drawings, Figure 1 is a perspective view of the cut-off mechanisms of two engines, with connections embodying my invention; and Fig. 2, a vertical section of one of the wheel-governors and the loose eccentric.

A and B represent the cut-off mechanisms of two engines, which run dynamo or magneto electric machines feeding into the same conductors, and having means for regulating them, as required, by the addition or removal of translating devices, as described and shown in my application before referred to. The shaft *a* of each engine has a loose eccentric, which may be in one part, but is preferably in two parts, *b c*, as shown. The eccentric-sleeve *d* is connected with the valve-rod C. The fly-wheel of each engine (not shown) has weights *e f* pivoted thereto, and thrown inwardly toward the shaft by springs *g*. Secured to shaft *a*, near the weight *e f*, are arms *h*, in which are pivoted bell-cranks *i*, connected with the weights and with a sleeve, E, feathered upon the shaft *a*. This sleeve has a grooved collar, *k*, with which engages the forked end of a pivoted lever, F. At its other end the lever F is connected removably with an arm, *l*, projecting from a shaft, G. The cut-off mechanisms of all the engines are connected with the shaft G in a similar manner, and the engines forced to work in unison.

What I claim is—

1. The combination, with two or more separate engines having automatic cut-off mechanisms composed of loose eccentrics and wheel-governors adjusting such eccentrics, of a sliding sleeve feathered on the shaft of each engine, means connecting such sleeve to the governor-weights so as to be moved thereby, and means connecting the sliding sleeves of all the engines together, substantially as set forth.

2. The combination, with two or more separate engines having automatic cut-off mechanisms composed of loose eccentrics and wheel-governors adjusting such eccentrics, of a sliding sleeve feathered on the shaft of each engine, means for connecting such sleeve to the governor-weights so as to be moved thereby, a pivoted lever engaging a collar on such sleeve, and means connecting the levers of all the engines together, substantially as set forth.

3. The combination, with two or more separate engines having automatic cut-off mechanisms composed of loose eccentrics and wheel-governors adjusting such eccentrics, of a sliding sleeve feathered on the shaft of each engine, bell-cranks connecting the sleeve and governor-weights, a pivoted lever engaging a collar on the sleeve, and a shaft connecting the levers of all the engines together, substantially as set forth.

This specification signed and witnessed this 19th day of October, 1882.

THOS. A. EDISON.

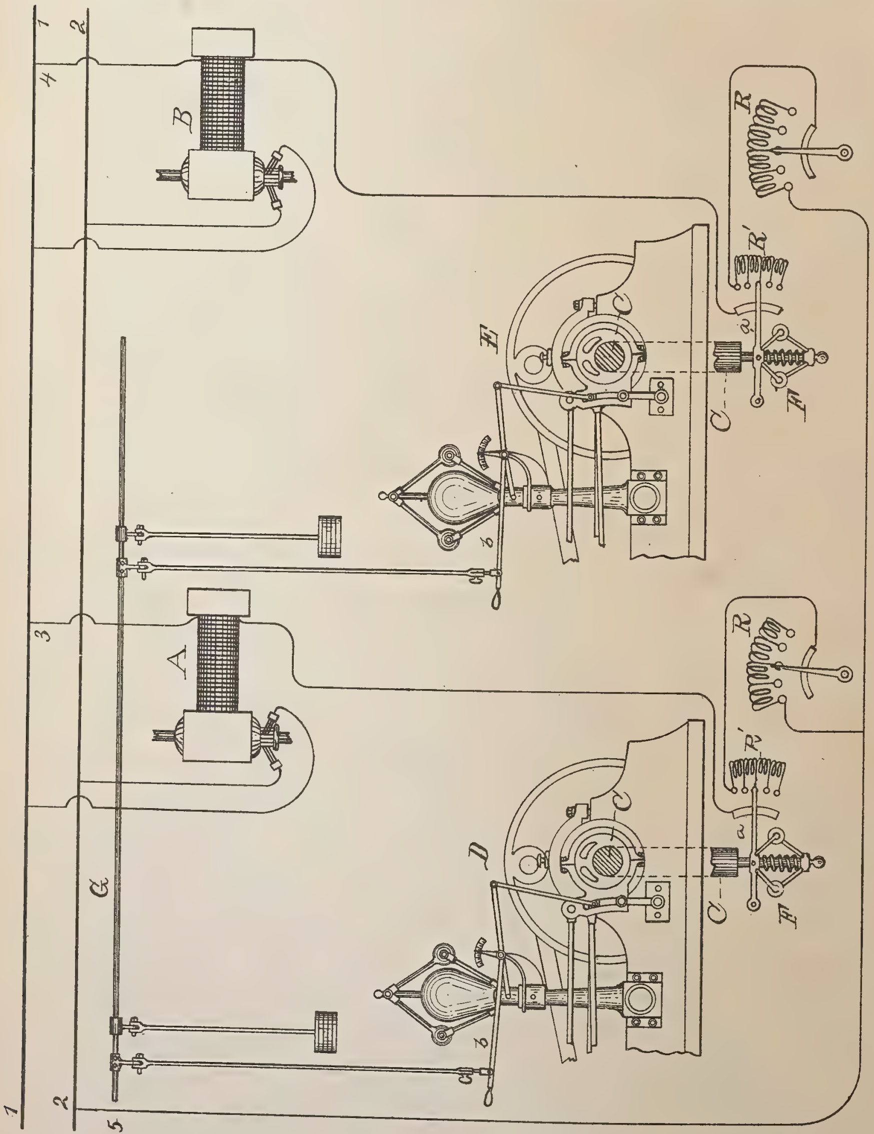
Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 271,616. Patented Feb. 6, 1883.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,

Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 271,616, dated February 6, 1883.

Application filed October 20, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Operating Electrical Generators, (Case No. 497,) of which the following is a specification.

The object I have in view is to maintain a uniform electro-motive force in all of a number of dynamo or magneto electric machines operated by two or more separate engines or motors and feeding into the same conductors or system of conductors, in order to avoid the racing of the engines and the loss of power caused by conversion of part of the generators into electromotors by reason of variations in the speed of the engines. This I accomplish by the use, in connection with each engine, of a mechanism controlled preferably by the speed of the engine, and arranged to regulate the electro-motive force of the generator or generators driven by it, so as to counteract the effect of the variations in the speed of the engine and maintain a uniform electro-motive force. This mechanism is employed in addition to the devices for varying the electro-motive force of the generator or generators as required by the addition or removal of translating devices, its office being simply to maintain the electro-motive force for which the machines are adjusted. I also prefer to employ means for causing all the engines to run in unison, as described in my application No. 488, (Serial No. 74,096;) but such means may be dispensed with.

The invention is illustrated in the accompanying drawing, which is a view of the principal parts of the cut-off mechanisms of two steam-engines, the generators driven thereby, but shown separated for clearness, and the regulating devices.

A B represent dynamo or magneto electric machines, which are of any suitable pattern and have their commutators connected with the same conductors, 1 2, or the same system of conductors. There may be any desired number of these generators connected in multiple arc, as shown, or in series or multiple series. Each generator is preferably coupled directly with the engine-shaft C, there being two engines, D E, shown, one for each generator; but it is evident that the generator can be connected with the engine-shaft by an endless belt, or by gearing, or that two or more generators (a battery) can be run by one engine, or that two or more engines can be used to operate each battery of generators. In short, the invention is applicable to any arrangement wherein dynamo or magneto electric machines are operated by separate sources of motive power, without regard to whether the electrical generators are divided into lots of one or more, or to whether each source of motive power is composed of one or more engines or motors. The arrangement shown is that preferred by me, each generator being run by a separate steam-engine. The field-circuits 3 5 and 4 5 of the generators are preferably separate multiple-arc circuits from 1 2, although they may be from another source of electrical energy. Each generator is provided with means for regulating its electro-motive force, as required by the addition or removal of translating devices, such means being preferably an adjustable resistance, R′, in its field-circuit. The means preferred for maintaining a constant electro-motive force of each generator controlled by the speed of the engine is a spring-governor, F, located directly upon the engine-shaft, or upon a spindle run from the engine-shaft. The pivoted lever *a* of the governor forms the contact-arm of an adjustable resistance, R′, located directly in the field-circuit of the generator. At a mean speed the lever *a* will be in contact with the central point of the resistance R′. Any increase of speed of one engine independent of the others would ordinarily increase the electro-motive force of the particular machine beyond that of the others. This increase of speed, however, throws a further part of the resistance R′ into the field-circuit of the machine, increasing the resistance of the field-circuit and counteracting the effect of the increase in speed. A decrease of speed has the contrary effect, throwing resistance out of the field-circuit. Thus it will be seen that the machines will always have the same electro-motive force notwithstanding variations in the speed of the engines.

Instead of having the extra resistance worked by a spring-governor, it may be adjusted by hand, which would enable the engineer to compensate for differences in speed be-

tween the engines, due to differences in friction or other causes.

The means described for maintaining uniform electro-motive force independent of variations in speed of the engines may be employed when a mechanical or electrical mechanism is used connecting the engines, so that they will work in unison, as described in my application before referred to.

On account of differences in friction, or from other causes, the mechanism for producing unison in speed may not, under all conditions, have the required efficiency. Hence the mechanism for maintaining uniform electro-motive force independent of variations in speed is useful in connection with it, although either mechanism may be used without the other.

Automatic cut-off engines of the Porter and Allen type are shown for illustration. The governor-arms *b* of these engines are connected removably and adjustably with the common shaft G, whereby any variation of the cut-off mechanism of one engine will produce a corresponding and simultaneous variation of the cut-off mechanisms of the other engines.

What I claim is—

1. The combination, with two or more independent engines and dynamo or magneto electric machines operated thereby and feeding into the same conductors, of means controlled by the speed of each engine for maintaining a constant electro-motive force of the generator or generators operated by it by compensating for variations in speed, whereby the electro-motive force of all the generators will be uniform, substantially as set forth.

2. The combination, with two or more independent engines and dynamo or magneto electric machines operated thereby and feeding into the same conductors, of means for varying the electro-motive force of the machines as required by the addition and removal of translating devices, and means for regulating each generator to compensate for differences in the speed of the engines, substantially as set forth.

3. The combination, with two or more independent engines and dynamo or magneto electric machines operated thereby and feeding into the same conductors, of means connecting the throttle-valve or cut-off mechanisms of the engines, and producing simultaneous and corresponding movements of such parts, and means controlled by the speed of each engine for maintaining a constant electro-motive force of the generator or generators operated by it, substantially as set forth.

4. The combination, with two or more independent engines and dynamo or magneto electric machines operated thereby and feeding into the same conductors, of means connecting the throttle-valve or cut-off mechanisms of the engines, and producing simultaneous and corresponding movements of such parts, means for regulating each generator to compensate for differences in the speed of the engines, and means for varying the electro-motive force of the generators as required by the addition or removal of translating devices, substantially as set forth.

This specification signed and witnessed this 16th day of October, 1882.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,

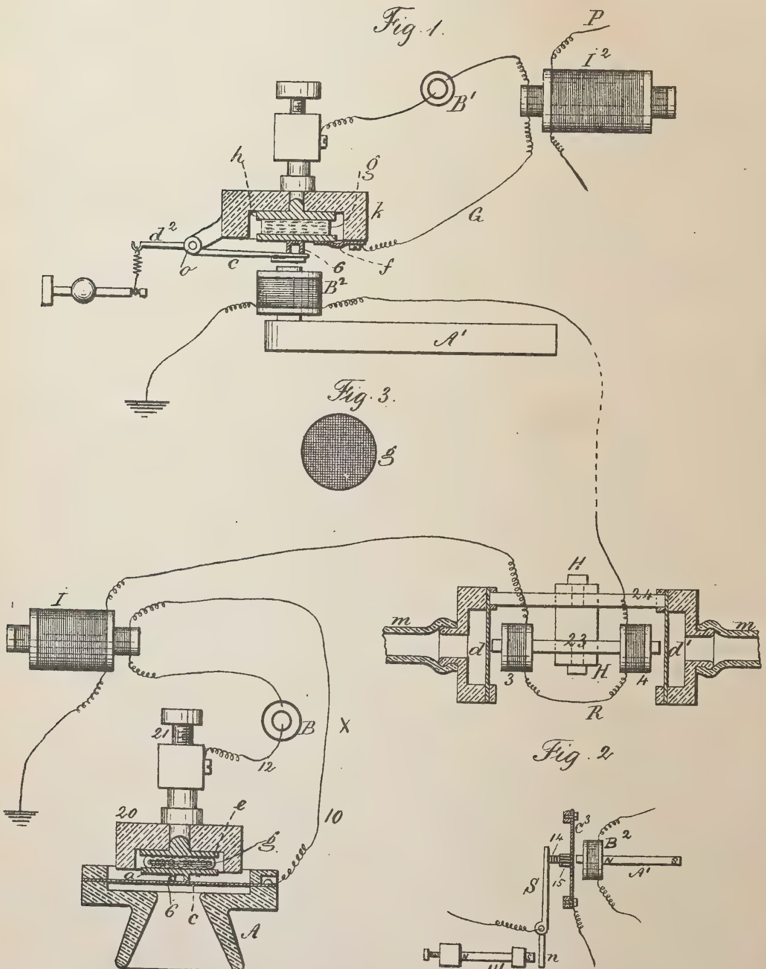
H. W. SEELY.

(No Model.)

T. A. EDISON.

TELEPHONE.

No. 272,034. Patented Feb. 13, 1883.



Witnesses:
J Hail
Chas H. Smith

Inventor
Thomas A. Edison
per Lemuel W. Serrell atty

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 272,034, dated February 13, 1883.

Application filed October 6, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Telephones, of which the following is a specification.

This application is a division of my application filed November 18, 1878, No. 159, and said division is made for the purpose of separating from the said original application the different features of invention into three additional applications. The present I term "Case No. 159A."

In my application No. 130, heretofore filed, the circuit passes through plumbago or similar material, and the diaphragm that is acted upon by the sound-waves serves to vary the electric tension by the extent of surface-contact.

In my case No. 151, patented April 30, 1878, No. 203,016, I have shown an induction-coil with primary and secondary circuits and receiving and transmitting telephones. A carbon button in a circuit, and acted upon by the diaphragm, is shown in my said case 151, and also in case 141. These are not therefore claimed herein.

In my present improvement I make use of a surface or surfaces having numerous points produced by scores or fine lines across the surface, preferably about at right angles to each other, and this surface or surfaces are in the electric circuit, and combined with the diaphragm, so that the movement given to the diaphragm by the sound-waves will produce greater or less intimacy of contact at the scored surface, and a consequent rise and fall of electric tension. I also combine with a button of carbon or equivalent material in one circuit an electro-magnet in another circuit, the armature of which varies the pressure upon such carbon or other finely-divided material, and by this means repeats the telephonic pulsations. I also construct the telephonic receiver in a peculiar manner to prevent injury by undue currents—such as from lightning—and so that the diaphragms and cores will be polarized by induction and the line-current will act in two helices to vary the magnetism.

In the drawings, the diagram Figure 1 represents the transmitting, receiving, and repeating instruments, the instruments at X being at one station, and the instruments at G being at the repeating-station. Fig. 2 is a detached view of a modification of the repeating-instrument, and Fig. 3 is a face view of the tension-regulator formed by a surface scored with numerous lines.

The telephonic transmitter A is made with a case containing the diaphragm or plate *c*, against which the sound acts to vibrate the same. The plate *e* is in the bottom of a vulcanite cup or holder, 20, and can be adjusted nearer to or farther from the diaphragm *c* by the screw 21. The tension-regulating device *g* is between the plate *e* and the second plate, *a*, the wires 10 and 12 of the circuit to the battery B connecting, so that the circuit passes through these plates and the intervening tension-regulator. The tension-regulating device is composed of two contiguous surfaces, one or both of which is scored with numerous fine lines, so as to produce a great number of contact-points. By adjusting the screw 21 the initial pressure can be regulated, and the vibrations of the diaphragm, due to the action of sounds, will vary the pressure and the extent of surface-contact, so as to produce rise and fall of tension in the circuit, by bringing more or less of the points on the surface or surfaces into contact. In Fig. 3 I have shown the surface scored as aforesaid, and it is to be understood that the scoring is to be of the requisite fineness, preferably several thousand to the inch.

In the instrument A, Fig. 1, the tension-regulator is composed of a strip of platina scored by lines of ruling at right angles, and folded with a piece of felt, rubber, or similar material within the fold, and the scored surfaces in contact with the plates *a* and *e*, respectively. Several layers of foil, ruled as aforesaid, may be placed together, if desired, to obtain great resistance and variation in the electric tension of the circuit. The foil, ruled as aforesaid, is believed to operate in the circuit in a similar manner to a carbon button. Between the diaphragm *c* and plate *a* there is a short section of a tube, 6, to form a central bearing.

The inductorium I has its primary included in the circuit to the battery B and tension-regulator, and its secondary to the line and ground.

The receiving-telephone R is placed in the line-circuit passing through the secondary of the inductorium, so that it is always in posi-

tion to receive a message sent over the line without the change of any switches or connections.

At the receiving-instrument R there is a permanent magnet, H, and upon one pole there is a bar, 23, forming at its ends the cores for the helices 3 and 4, that are in the line-circuit, and upon the other pole of the magnet H there is a bar, 24, that is connected at its ends to the diaphragms *d d′*. These diaphragms hence are polarized by induction, and are of one polarity—say south—while the cores of 3 and 4 are polarized north by induction. Flexible tubes *m*, with ear-pieces, are connected to the chambers or cases holding the diaphragms *d d′*, so that the sound is conveyed to the ears.

This apparatus is not liable to become demagnetized, because any current which passes through the helices 3 and 4 acts to increase the induced magnetism at one end of the bar 23 in proportion as it tends to decrease the induced magnetism in the other end. Thus there will be no tendency to injure the permanent magnet H; but the telephonic current will cause the diaphragms to respond by the change of magnetism in the cores adjacent to the diaphragms.

The repeating-instrument at the station G contains an electro-magnet, B^2, the helix of which is in the main-line circuit. Its core is adjacent to an iron plate or armature, and the variation of the magnetism resulting from rise and fall of electric tension in the main line increases and decreases the pressure upon a button of carbon, *g*, or similar material forming the tension-regulator in a second electric circuit. I have shown the local circuit from the battery B′ as passing to the plate *f* at one side of the circuit regulator *g*, and to the adjusting device of the plate *h* at the other side of the carbon or similar material, and in this local circuit is the primary of the inductorium I^2, the secondary of which is in the line P to the distant receiving-instrument.

I prefer to connect the core of the electro-magnet B^2 to one pole of the permanent magnet A′, so that it may be polarized by induction, and hence the line-circuit will increase or decrease the magnetism of the core of B^2. The armature-plate of the magnet B^2 is shown upon a lever, *c*, having a fulcrum at *o*, and the spring at d^2, which should be adjustable, serves to apply an initial pressure to the tension-regulator *g*, and I prefer to use a short cylinder, 6, between the armature-plate and the disk *f* to insure a central bearing on the tension-regulator. When an electric wave from the distant station varies the power of the magnet B^2, the pressure upon the tension-regulator *g* is decreased or increased, and the primary current from B′ acts in the inductorium to translate or reproduce on the second line, P, currents corresponding or proportionate to those sent from the instrument A.

The instrument shown in Fig. 2 is a very delicate translator, acting similarly to that in Fig. 1. The electro-magnet B^2 has a helix in the line-circuit, as before, and A′ is its polarized core. C^3 is a diaphragm, and S is a lever, the short end *n* of which is attracted by an adjustable magnet, H′. Between the lever S and diaphragm C^3 there are the pieces 14 and 15 of carbon or other finely-divided material, that act as a tension-regulator for the translating or repeating circuit that passes through the lever S and diaphragm C^3. Hence the rise and fall of electric tension in the repeating-circuit will result from the vibrations of the diaphragm. producing more or less pressure and intimacy of contact in the tension-regulator at 14 15, the initial pressure being determined by the proximity of the magnet H′ to the lever S.

It will be observed that in my telephone-instruments I provide an electric tension-regulator having an extended surface, in contradistinction to a point or small bearing, such as shown in my application No. 141, and instead of the electric tension-regulator coming directly into contact with the diaphragm, as in my application No. 130, I combine with the electric tension-regulating device an intermediate bearing, having a small contact with the diaphragm and the required extent of surface against the tension-regulator. This bearing is non-elastic, to transfer more positively to the tension-regulator the tremulous movements of the diaphragm as distinguished from the yielding material—such as cork or rubber—as shown in my Patent No. 203,016. If the current passes through this non-elastic bearing-piece, as at A, the same is to be of metal or other good conductor.

Certain of the devices shown herein are not claimed, as they form the subject of other applications.

I claim as my invention—

In a telephonic receiving-instrument, two helices, 3 and 4, and the core 23, that is magnetized by induction, in combination with a permanent magnet, H, and two diaphragms that are connected to the magnet H, so as to be magnetized by induction, substantially as set forth.

Signed by me this 30th day of March, A. D. 1882.

THOMAS A. EDISON.

Witnesses:

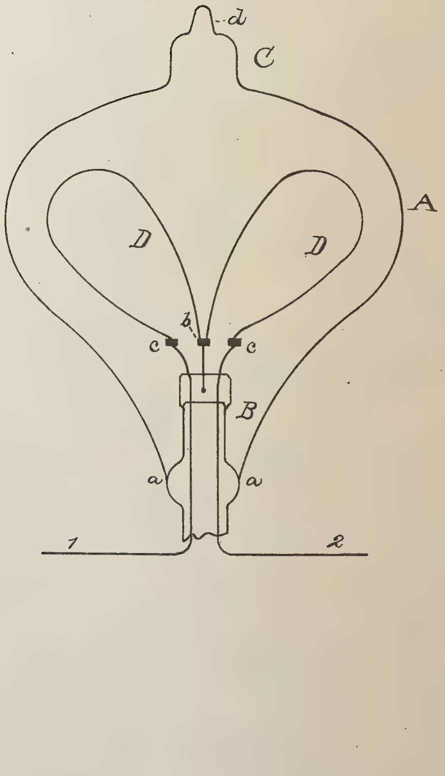
GEO. T. PINCKNEY,
HAROLD SERRELL.

(No Model.)

T. A. EDISON.

INCANDESCING ELECTRIC LAMP.

No. 273,485. Patented Mar. 6, 1883.



ATTEST:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCING ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 273,485, dated March 6, 1883.

Application filed November 9, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Electric Lamps, (Case No. 508,) of which the following is a specification.

In the use of incandescing electric lamps it may sometimes be desired that the light-giving body shall be of a broad, flat shape similar to that of a gas-flame. My object is to provide a lamp of this character.

In the lamp which I have devised the incandescing conductor consists of two flexible "horseshoe-shaped" filaments of carbon, connected together within the globe in series, and diverging or spreading out from each other, so that the effect of a broad, flat flame is produced, the conductor being supported in the middle from the glass inner stem of the lamp. Such filaments are attached to the inner stem by means of the leading-in wires and a central wire-support sealed therein, and are placed in the lamp together, they being first folded or bent together, so that they may pass through the opening at the bottom of the globe. The stem is sealed, as usual, in the bottom of the globe. The top of the globe is provided with an opening of sufficient size to admit a suitable tool, which is put through this opening and used to bend the filaments apart and into the desired form. By using this process the opening at the bottom of the tube and the stem which is sealed within such opening may be made of the usual small diameter, whereas if the filaments were spread out before being placed in position a very large opening would be required to allow of their entrance, and a correspondingly large stem would of course be required to fit closely and be sealed within said opening. After the filaments are placed in position an exhaust-tube is sealed to the top of the globe, through which the air is exhausted, the carbon being heated to incandescence during the exhausting process, and the exhaust-tube is then sealed off close to the top of the globe.

By the use of the devices and process described I produce a lamp of very high resistance, and of an ornamental and desirable construction.

My invention is illustrated in the annexed drawing, which is a view in elevation of a lamp embodying said invention.

A is the inclosing-globe, and B the inner glass stem or wire-support through which the leading-in wires 1 2 pass. Such stem is sealed in the bottom of the globe at *a a*. The globe is provided with a projection, C, at its top, which originally is left open.

D D are the two carbon filaments, electroplated or otherwise attached together at *b*, and to a supporting-wire sealed into the stem, and attached to the leading-in wires 1 2 at *c c*, so that they are connected in series. The filaments are folded together, so that they may be passed through the opening *a a*, and after the stem B is sealed within said opening a tool is introduced through C, and the filament bent apart, as shown. The globe is exhausted through a tube attached at C, and such tube is then sealed off at *d*.

The form of the incandescing conductor and of the globe will be made the subject of an application for Design Patent.

What I claim is—

1. The method of manufacturing electric lamps consisting in attaching two flexible filaments connected and folded together to the inner stem or wire-support, sealing such stem within the bottom of the globe, and then bending said filaments apart and into the shape shown, substantially as set forth.

2. An incandescing electric lamp composed of the globe A, provided with enlargement C, the wire-support B, the diverging filaments D D, the leading-in wires, and the central wire-support, substantially as set forth.

This specification signed and witnessed this 26th day of October, 1882.

THOS. A. EDISON.

Witnesses:

WM. H. MEADOWCROFT,
H. W. SEELY.

(No Model.)

T. A. EDISON.

INCANDESCING ELECTRIC LAMP.

No. 273,486. Patented Mar. 6, 1883.

Fig. 1.

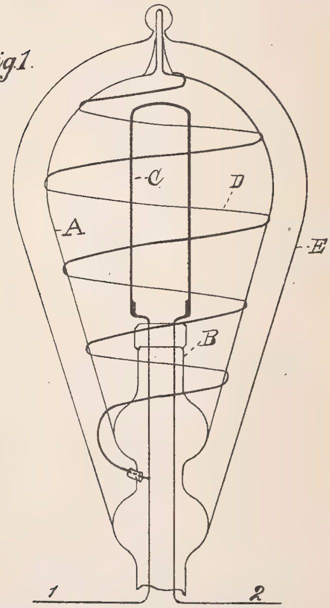


Fig. 2.

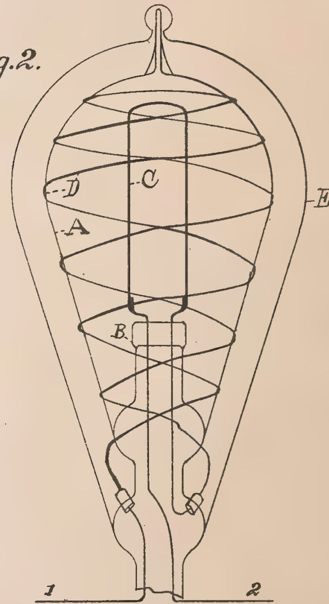


Fig. 3.

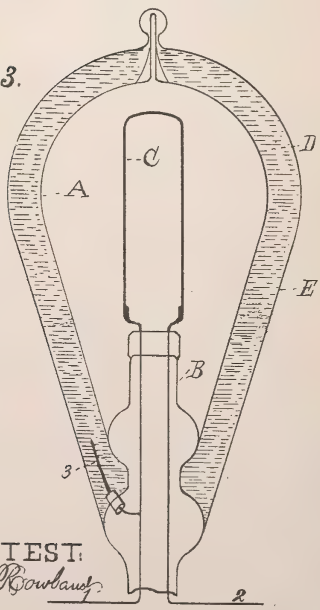
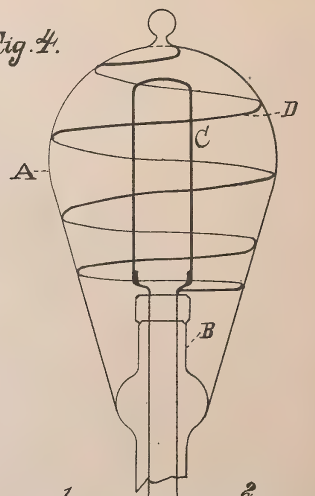


Fig. 4.



ATTEST:
E. C. Rowland
H. W. Seely

INVENTOR.
Thomas A. Edison,
By Richd. N. Dyer,
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCING ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 273,486, dated March 6, 1883.

Application filed October 20, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Methods of and Means for Preventing Electrical Carrying in Incandescing Electric Lamps, (Case No. 493,) of which the following is a specification.

In the use of incandescing electric lamps particles are thrown off from the carbon filament and deposited upon the glass inclosing-globe, resulting in the gradual destruction of the filament and the blackening of the globe, obscuring the light. This, I think, is due to the static attraction between the glass globe and the heated electrified particles, the globe having a lower potential than the filament. In my application No. 479 (Serial No. 74,095) is shown and described means for neutralizing this static attraction.

The object of my present invention is more especially to produce more efficient means for the purpose. This I accomplish by bringing the conductor connected with one of the leading-in wires of the lamp directly into contact with the glass globe, which has the effect of raising the globe to the same or nearly the same potential as the filament. When the conductor for neutralizing the static attraction is attached to the outside of the inclosing-globe, to prevent the discharge of the electricity I provide an external protecting-globe, which protects the neutralizing-conductor from the effects of the surrounding atmosphere. If the neutralizing-conductor is a solid material—such as a wire or strip of metal, carbon, or other suitable material—the external globe will be exhausted and sealed with or after the main lamp or globe; but if this neutralizing-conductor is a transparent or semi-transparent liquid or other mass the space between the main and protecting globes may be filled with the liquid or mass and sealed before or after the lamp-globe is exhausted. A heavy oil or substance, like Canada balsam or olive oil or water, may be used for the purpose, and a metal wire attached to one of the leading-in wires of the lamp is immersed in the liquid, so that the same will be electrically charged. If platinum is used for the neutralizing-conductor, it may be fused to the glass of the globe or not, as desired. When the neutralizing-conductor is placed within the lamp-globe the external protecting-globe is dispensed with. The internally-arranged conductor may be sustained in position against the globe by its own resiliency; or if platinum is used it can be attached to the globe by a fusion of the glass. When the neutralizing-conductor is located within the lamp-globe I prefer to connect it with the negative wire of the lamp, and when such neutralizing-conductor is external to the lamp-globe I prefer to connect it with the positive wire of the lamp. The neutralizing-conductor may be placed directly in the circuit of the filament, it being of low resistance, so as not to be heated by the passage of the current therethrough.

In the accompanying drawings, forming a part hereof, Figure 1 is a view of a lamp with an external neutralizing-conductor connected to one leading-in wire; Fig. 2, a similar view when the neutralizing-conductor is in circuit with the filament; Fig. 3, a view of a lamp with a protecting-globe and a liquid neutralizing-conductor, and Fig. 4 a view of a lamp having an internal neutralizing-conductor.

Like letters denote corresponding parts in all four figures.

A is the exhausted and sealed glass globe of the lamp; B, the tube supporting the carbon filament C and the leading-in wires 1 2.

D is the neutralizing-conductor, bearing directly upon the globe A and in contact therewith, either upon the outside or inside of the globe. The neutralizing-conductor may be connected with one of the leading-in wires 1 2, its other end being free, as shown in Figs. 1, 3, and 4; or the neutralizing-conductor may be in circuit with the filament, as shown in Fig. 2.

E is the outer protecting-globe, which is used when the neutralizing-conductor is located on the outside of the lamp-globe A. This protecting-globe is exhausted and sealed with or after the lamp-globe; but where a liquid is used, as in Fig. 3, the space within the protecting-globe is filled with the liquid. This liquid is connected with one of the leading-in wires by a wire, 3, sealed into the glass and immersed in the liquid.

I do not wish to express a preference for any one of the arrangements described and shown,

since, although I have tried them all, I cannot immediately determine the best form, on account of the long time required to make a comparative test of the life of the lamps.

What I claim is—

1. The method of preventing electrical carrying in incandescing electric lamps, consisting in raising the globe to the same or nearly the same potential as the filament, substantially as set forth.

2. In incandescing electric lamps, the combination, with the filament and the inclosing-globe, of a neutralizing-conductor connected with the lamp-circuit and located in contact with the lamp-globe, substantially as set forth.

3. In incandescing electric lamps, the combination, with the lamp-globe and the neutralizing-conductor external thereto, of the outer protecting-globe, substantially as set forth.

4. In incandescing electric lamps, the combination, with the lamp-globe and the neutralizing-conductor of solid material external thereto, of the outer exhausted protecting-globe, substantially as set forth.

This specification signed and witnessed this 12th day of October, 1882.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

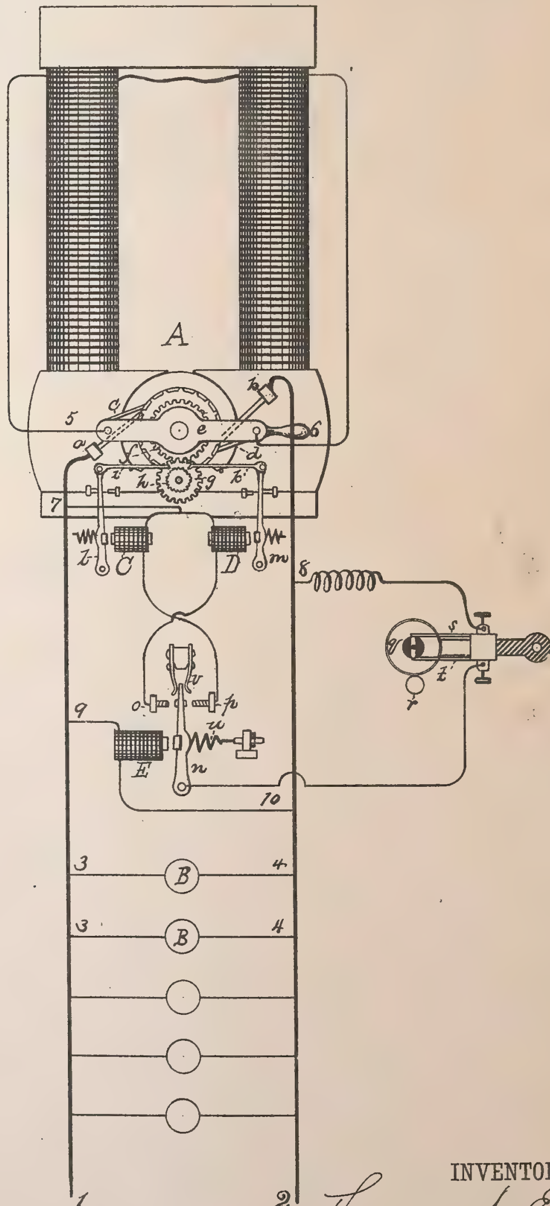
RICHD. N. DYER.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 273,487. Patented Mar. 6, 1883.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Richd. N. Dyer.

Atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 273,487, dated March 6, 1883.

Application filed September 22, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Regulating Electric Generators, (Case No. 443;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object I have in view is to produce simple and efficient means for automatically regulating the generative capacity of a dynamo or magneto electric machine which will regulate both for changes in the number of translating devices and in the speed of the engine. This I accomplish by taking from the commutator-cylinder of the machine a separate current for the field-of-force circuit by means of one or more extra commutator-brushes adjusted by mechanism operated or controlled by an electro-magnet placed in a multiple-arc circuit from the main conductors, so as to be affected exactly as are the lamps.

The arrangement for obtaining the separate current at the commutator-cylinder may be any one of those described in a previous application for patent filed by me, (Serial No. 68,626,) the extra brush or brushes being adjusted by a double pawl-and-ratchet vibrating mechanism controlled by the electro-magnet in multiple arc.

The foregoing will be better understood from the drawing, which is a view, partly diagrammatic, of apparatus embodying the invention.

A is a dynamo or magneto electric machine, from the main commutator-brushes *a b* of which run the main conductors 1 2. These main brushes are supported in any usual or suitable way, the drawing showing them diagrammatically for clearness of illustration.

The lamps or other translating devices B are located in multiple-arc circuits 3 4 from 1 2.

Two extra brushes, *c d*, bearing on the commutator-cylinder, are mounted upon a yoke, *e*, pivoted on the armature-shaft. The field-of-force circuit 5 6 of the machine is taken from these brushes *c d*. The yoke *e* has secured to it a cog-wheel, *f*, with which meshes a cog-wheel, *g*, keyed to the same spindle, with two oppositely-turned ratchet-wheels, one of which is shown at *h*. With these ratchet-wheels engage two pawls, *i k*, carried by the armature-levers *l m* of electro-magnets C D, the levers being retracted by springs. The circuit of these electro-magnets may be a circuit derived in any suitable way from the conductors supplied by the machine. It is shown as a multiple-arc circuit, 7 8, from the main conductors 1 2. This circuit passes through the armature-lever *n* of an electro-magnet, E, the circuit being divided at the front and back contacts, *o p*, of this lever, and the magnets C D being located in the separate divisions of the circuit. The circuit 7 8 also passes through a circuit-breaker, which may be a circuit-breaking wheel, *q*, driven by the armature-shaft *r*, or any other moving part. The spring-fingers *s t* rest on the breaking-hub of this wheel, and the circuit-connections are made with these spring-fingers. The electro-magnet E is located in a multiple-arc circuit, 9 10, from 1 2. Its armature-lever *n* is retracted by an adjustable spring, *u*, and is held at a central point intermediate between its contact-points by spring-fingers *v*. When the current increases to a definite extent the lever of E will make its front contact, completing circuit through D, and causing its lever to vibrate with the assistance of the circuit-breaker. This movement will turn the yoke *e* and throw the brushes *c d* on the commutator-cylinder away from the line of greatest generation. When the candle-power of the lamps becomes normal the lever *n* will resume a central position, breaking the circuit 7 8. Upon a definite decrease of current the lever *n* will make its back contact, energizing C and throwing the brushes *c d* toward the line of greatest generation. The brushes *c d* may work upon a different portion of the commutator-cylinder from the main brushes, so that they will not interfere with each other. The extra brushes may therefore be adjusted to the points of greatest generation, or away from it, and the field-circuit may have the same electro-motive force as the main circuit, or a lower electro-motive force.

Instead of using two extra brushes to which the ends of the field-wire run, one extra brush may be used, connected with one end of the

field-wire, while the other end of the field-wire will be connected with a main brush; or two extra brushes forming one pole may be used, a main brush forming the other pole, as described in my application Serial No. 68,626. The adjustment of the extra brush or brushes by the mechanism before described will effect the regulation of the machine.

What I claim is—

1. The combination, with a dynamo or magneto electric machine having the current for its field-circuit taken from its commutator-cylinder by means of an extra brush or brushes, of means for automatically adjusting said extra brush or brushes to effect the regulation of the machine, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine supplying translating devices in multiple arc, and having the current for its field-of-force circuit taken from the commutator-cylinder by means of an extra brush or brushes, of mechanism for adjusting such extra brush or brushes, and an electro-magnet located in a multiple-arc circuit and operating or controlling the operation of said adjusting mechanism, substantially as set forth.

3. The combination, with a dynamo or magneto electric machine supplying translating devices in multiple arc, and having the current for its field-circuit taken from its commutator-cylinder by an extra brush or brushes, of mechanism for adjusting such extra brush or brushes, and an electro-magnet located in a multiple-arc circuit, the armature-lever of which completes at its front and back contacts separate circuits through the adjusting mechanism, causing it to move in opposite directions, substantially as set forth.

4. The combination, with a dynamo or magneto electric machine supplying translating devices in multiple arc, and having the current for its field-circuit taken from its commutator-cylinder by an extra brush or brushes, of two electro-magnets working oppositely, moving pawls and ratchets, a circuit-breaker in the circuit of said magnets, and an electro-magnet in multiple arc completing the circuits of said first magnets at its contacts, substantially as set forth.

This specification signed and witnessed this 12th day of September, 1882.

THOS. A. EDISON.

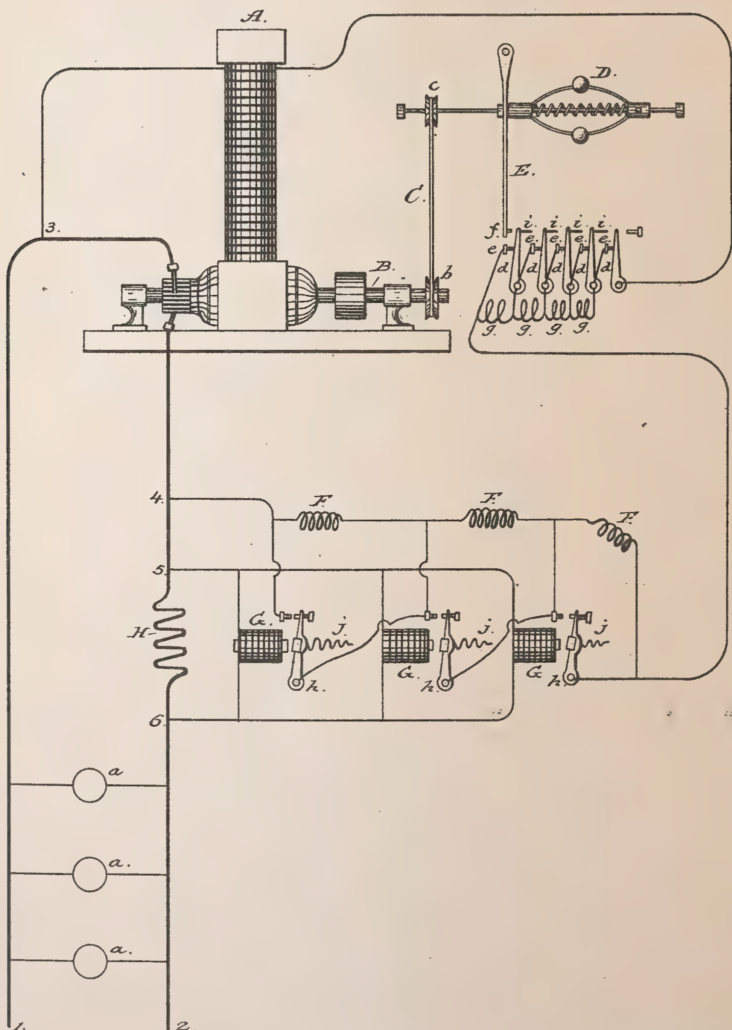
Witnesses:
WM. A. STERN,
H. W. SEELY.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 273,488. Patented Mar. 6, 1883.



WITNESSES:

E. C. Rowland

H. W. Howard

INVENTOR:

T. A. Edison

BY Richd. N. Dyer

ATTORNEY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 273,488, dated March 6, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Regulation of Dynamo or Magneto Electric Machines, (Case No. 413;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object of this invention is to produce a system of regulation for dynamo or magneto electric machines, which system shall consist of means for regulating the current both for an increase or decrease in the speed of the engine actuating the armature, and for variations in the number of translating devices in circuit.

The speed-regulator consists of a centrifugal governor connected to the armature or engine shaft or other revolving portion of the generating apparatus, and also to a movable arm whose motion throws portions of a resistance into or out of the field-circuit of the machine, an increase in the speed of the engine thus causing a movement of the governor and of the movable arm, which causes the immediate throwing in of resistance, and a decrease in speed causing a corresponding throwing out of resistance.

For regulating the machine according to variations in the number of translating devices in circuit, I use, preferably, a series of electro-magnets and movable armatures, the former placed in multiple arc to each other across a shunt around a resistance in the main line, and the latter each forming a part of a shunt around a resistance in the field-circuit. These armatures and electro-magnets are so arranged relatively to each other that different amounts of currents are required to cause each magnet to attract its armature, this being accomplished by making the retracting springs or weights of the armatures of different degrees of strength by placing the armatures at different distances from the magnets, or in any other suitable manner. Therefore as more translating devices are placed in circuit the successive increases of the current in the shunt which contains the electro-magnets cause the successive drawing forward of the pivoted armature, and the shunts around the field-circuit resistance are closed one after another, the resistances thus being successively removed from circuit and the energy of the field-magnets increased. Various other arrangements of magnets and armatures may be used for this purpose, if desired, many such being described in former applications made by me for Letters Patent.

The foregoing may be better understood by reference to the annexed drawing, which represents my invention diagrammatically.

A is a dynamo-electric machine, shown in side elevation, and 1 2 are the main conductors leading therefrom, lamps or other translating devices *a a* being placed in multiple arc upon them.

3 4 is a multiple-arc circuit from the main line, which energizes the field-magnet of the machine; but a circuit supplied from any suitable external source may be used for this purpose.

B is the armature-shaft, on which is mounted a pulley, *b*, from which a belt, C, runs to another pulley, *c*, on the shaft of a centrifugal governor, D.

Attached to the governor D in such manner that it will be moved along the shaft by the backward and forward movements of the governor is an arm, E, the lower end, *f*, of which is opposite the free ends of the series of pivoted contact-arms *d d*. These arms normally make contact with points *e e*, the pins *i i* being of insulating material. In a shunt around each of said contacts is a resistance, *g*. A forward movement of the arm E forces the arms *d d* successively away from their contacts, and thus throws the resistances *g g* into the field-circuit 3 4. Such forward movement is produced by an increase of speed of the governor D, caused by an increase in the speed of the armature of the machine, and the increased and unnecessary generation of current produced by such an increase of speed is of course immediately counteracted by the throwing of one of the resistances *g* into the field-circuit.

In the field-circuit 3 4 are also placed resistances F F, and around each of such resistances is formed a shunt-circuit, which includes one of the pivoted armatures *h*. These arma-

tures have springs j, of different degrees of strength. The magnets G G, which attract the armatures, are in multiple arc across the shunt 5 6, which is formed around a resistance, H, in the main conductor 2. As more translating devices are placed in circuit and the energy of the magnets G increases the armatures h are successively drawn forward and the shunts around the resistances F F are closed, such resistances thus being removed from the field-circuit. As the number of translating devices in circuit is reduced a reverse operation takes place and the resistances F are again included in the circuit.

By using the two arrangements described in connection with each other the machine is automatically regulated both for changes in the amount of current required in the system and for variations in the speed of the motor which drives the armature.

It is evident that the governor D could be run from the shaft of the engine or from any moving part of the apparatus.

It is also evident that other forms of adjustable resistance than that shown could be used in connection with the governor, and that various other arrangements of magnets, armatures, and resistances could be made for the other portion of the regulator.

What I claim is—

1. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of adjustable resistance in the field-circuit of the machine, mechanical means connected with and operated by some moving portion of the machine, or of the motor actuating it, for varying such resistance according to variations in the speed of said motor, and an electro magnet or magnets energized by the current generated for varying such resistance, according to variations in the number of translating devices in circuit, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of an adjustable resistance in the field-circuit, a mechanically-operated device for varying such resistance, and a number of electro-magnets in a shunt from the main line, operating successively to vary such resistance, substantially as set forth.

This specification signed and witnessed this 1st day of May, 1882.

THOMAS A. EDISON.

Witnesses:
H. W. Seely.
P. B. Wilber.

(No Model.)

T. A. EDISON.

TURN TABLE FOR ELECTRIC RAILWAYS.

No. 273,489. Patented Mar. 6, 1883.

Fig 1

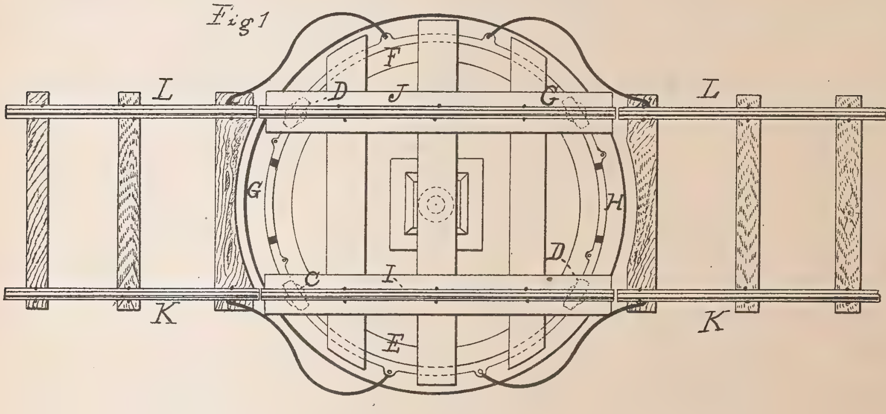
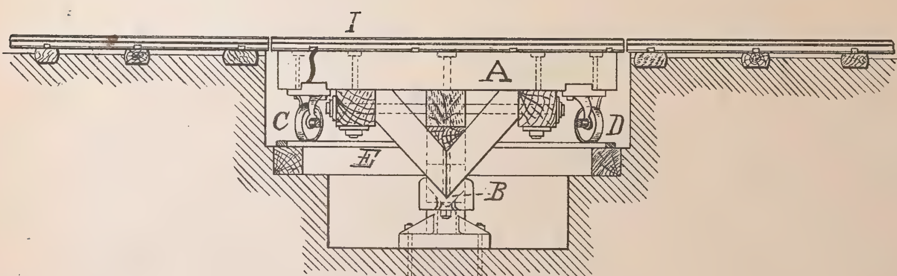


Fig 2.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

T. A. Edison

BY Richd. N. Dyer.

ATTORNEY.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

TURN-TABLE FOR ELECTRIC RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 273,489, dated March 6, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Turn-Tables for Electric Railways, (Case No. 430;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to provide a turn-table suitable for use with an electric railway in which the current actuating the trains is conducted to them through the rails of the track, which turn-table shall be so connected that there will be no danger of a short circuit when it is moved, and so that a car can be run onto the table and, after being reversed, receive current to move it off again.

My invention is illustrated in the accompanying drawings, in which Figure 1 is a top view of the turn-table, and Fig. 2 a vertical section of the same.

The turn-table consists of a frame-work, A, pivoted at its center B, and supported on four rollers, C C and D D, which run on a circular metallic track composed of two sections, F F, electrically divided from each other by means of two short insulated sections, G H, which, however, must be long enough not to allow a short circuit between the parts E F when the rollers pass from one to the other. Opposite rollers C C are connected to the rails I J of the turn-table, respectively, and the stationary rail K is connected to the section E of the circular track, while stationary rail L is connected to the section F, such connections being made by wires, as shown, or in any other suitable manner. The rollers D D, however, are insulated from all the rails.

It will be seen that a car may be run onto the turn-table, and will receive current through the circular track and the rollers C C, and after such car is reversed, on the circuit being completed to the armature of the electric motor on the car, (such circuit being of course broken while the car is being turned around,) current will reach the car in the same way to remove it from the turn-table again.

What I claim is—

1. In electric railways, the combination, with the stationary rails acting as conductors, of a turn-table and electrical connections of the stationary rails around the turn-table, whereby the flow of current through the stationary rails is not affected by the movement of the turn-table, substantially as set forth.

2. In electric railways, the combination, with the stationary rails acting as conductors, of a turn-table, electrical connections of the stationary rails around the turn-table, and electrical connections with the rails of the turn-table for supplying the same with currents, substantially as set forth.

3. In a turn-table for electric railways, the combination of the circular track divided into two electrically-insulated sections, the rollers running on said track, and the turn-table rails carried by said rollers, one pair of diagonally-opposite rollers being electrically connected with such rails, as shown, substantially as set forth.

4. In an electric-railway turn-table, the circular metallic track divided into two electrically-insulated sections, each of such sections being electrically connected with one line of the stationary rails, in combination with electrical connections between such sections and the rails of the turn-table, substantially as set forth.

This specification signed and witnessed this 9th day of June, 1882.

THOS. A. EDISON.

Witnesses:

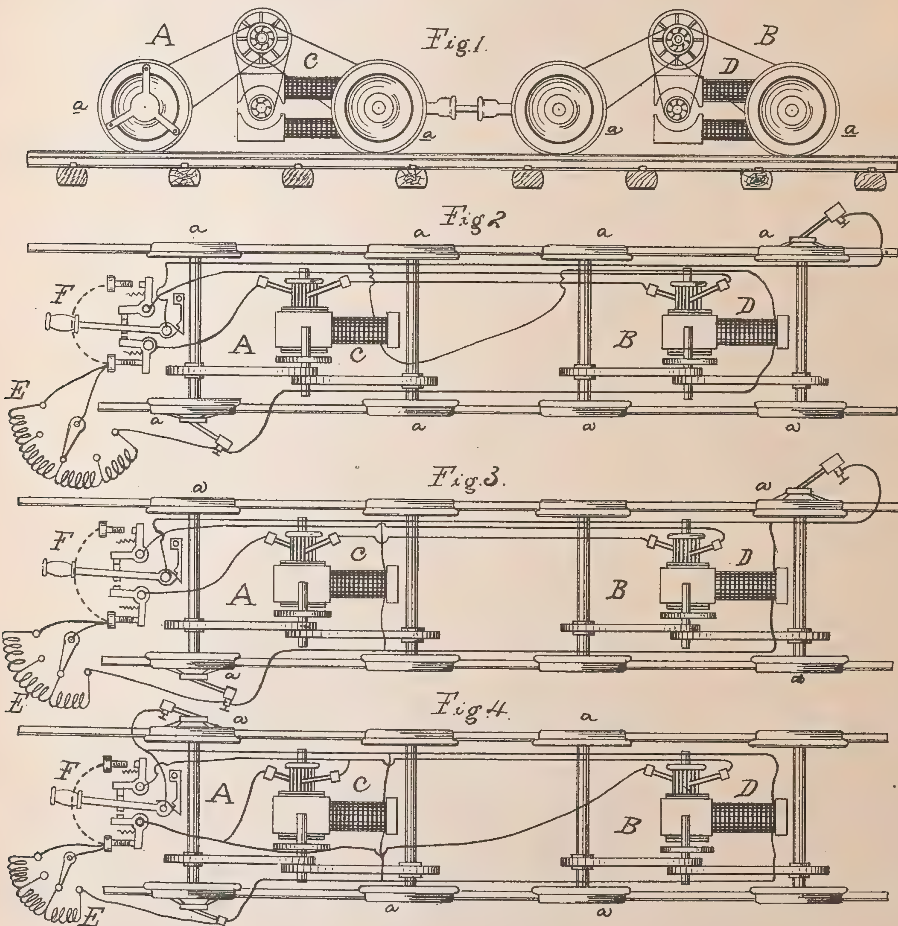
RICHD. N. DYER,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

ELECTRO MAGNETIC RAILWAY SYSTEM.

No. 273,490. Patented Mar. 6, 1883.



E. C. Rowland
H. W. Seely

INVENTOR:
T. A. Edison
BY Richd. N. Dyer
ATTORNEY.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRO-MAGNETIC RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 273,490, dated March 6, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electro-Magnetic Railway Systems, (Case No. 431;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to letters of reference marked thereon.

My invention relates to electric railways; and it consists primarily in utilizing the weight of all the cars of a train, or of two or more of such cars, for giving drawing-power, while the whole train is still controlled from a single point. An electric locomotive is usually very light compared with those in which steam is used, and therefore exerts but little adhesive force upon the rails, therefore when a heavy train is in use the driving-wheels are likely to slip, and the full benefit of the tractive power is not obtained. To obviate this is the object of my invention. The preferable way of accomplishing this object is as follows: Each car, or each truck of a car, is provided with two or more electro-dynamic motors, whose armatures are connected mechanically with the axles of the cars, so as to transmit motion thereto. All the armature-coils and all the field-magnet coils of the motors on the train are connected either in series or in multiple arc. The brushes which take current from the wheels on one side of the train may be on the forward car and those of the other side on the rear car, or both sets of brushes may be on the forward car. The current is preferably taken from two or more wheels of a car (instead of from one wheel) for each pole of the motor, the brushes used for this purpose being carried by an insulating-arm, along which the conductors run. The adjustable resistance for slowing down the train and the circuit controllers and reversers for all the circuits are placed on the forward car, so that the entire train may be controlled from that point. Instead of providing all the cars with motors, only certain cars of the train may be so constructed; or all the cars may be provided with motors, and only the motors of enough cars to give the necessary adhesive and tractive power connected up. The coupling devices for completing the electrical circuits will preferably be located at the ends of the cars, and will be so constructed and arranged that the simple coupling of opposing parts will complete the necessary circuits.

In the accompanying drawings, Figure 1 is a side elevation, showing two cars provided with motors. Figs. 2, 3, and 4 are top views, showing the electrical connections in diagram of the preferred form of my invention. The frame-work of the two cars is omitted in these figures for the sake of clearness.

A and B are the two cars. C and D, Figs. 1, 2, 3, and 4, are electro-dynamic motors mounted upon said cars, and having their armatures properly connected with the car-axles. The wheels *a* of the cars may all be constructed with rims insulated from their hubs, or only those on one side of a car need be so constructed.

In Figs. 2 and 3 the brushes or springs which take current from the wheels are placed one on the front, the other on the rear car, while in Fig. 4 both brushes are on the first car. In Fig. 2 the armature-coils of the motors are all in series, and so are the field-magnet coils. In Fig. 3 the armature-coils are in series, and the field-magnet coils in multiple arc, while in Fig. 4 both the armature-coils and the field-coils are in multiple arc. The armature-coils could of course be placed in multiple arc and the field-coils in series, if desired.

On one car, A, of a train are placed the adjustable resistance E and circuit controller and reverser F, which are fully explained in another application made by me. They are so arranged as to affect all the circuits of the train.

What I claim is—

1. The combination, in an electric railway-train, of electro-dynamic motors mounted on two or more cars of such train, and connected with the axles thereof, and means for controlling all such motors situated on one of said cars, substantially as set forth.

2. The combination, in an electric railway-train, of electro-dynamic motors mounted on two or more cars of such train, and connected with the axles thereof, and a circuit controller and reverser mounted on one of such cars and adapted to control or reverse the circuits of

all of said motors simultaneously, substantially as set forth.

3. The combination, in an electric railway-train, of electro-dynamic motors mounted on two or more cars of said train, and connected with the axles thereof, and a circuit controller and reverser, and an adjustable resistance situated on one of said cars and connected with the circuits of all of said motors, substantially as set forth.

This specification signed and witnessed this 9th day of June, 1882.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,

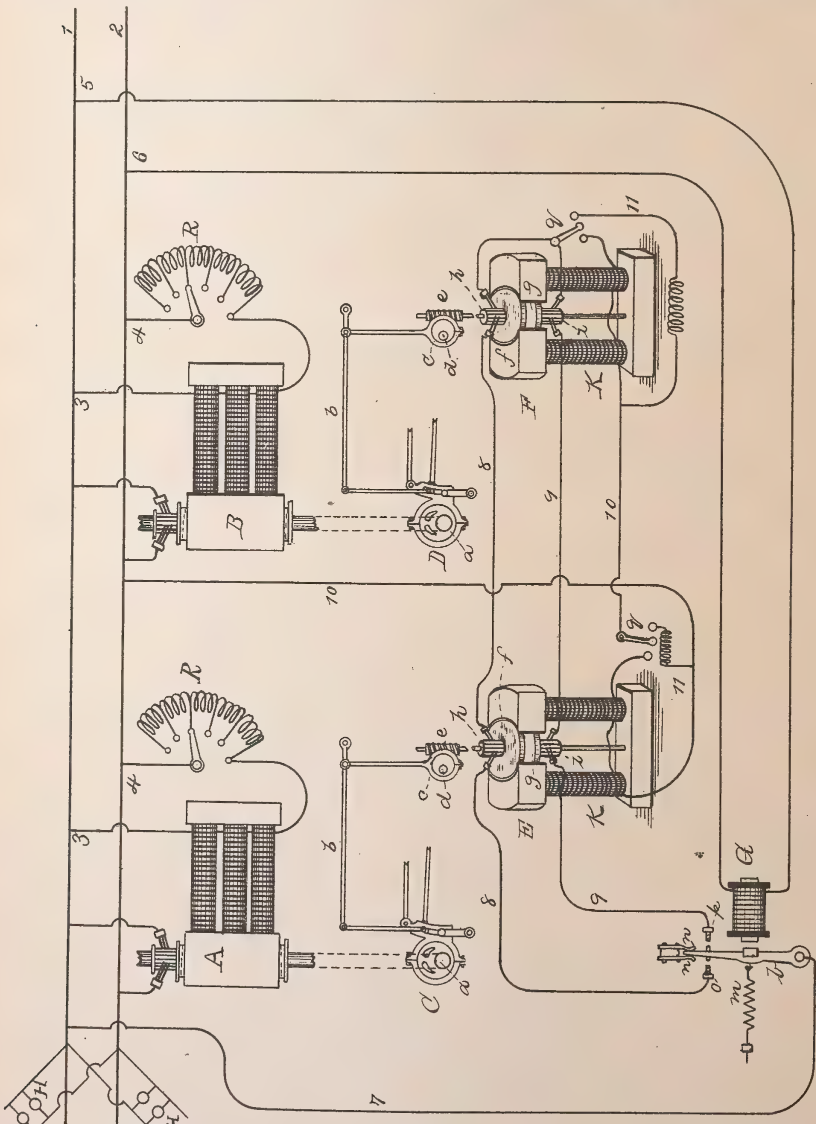
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DRIVING ENGINES OF ELECTRICAL GENERATORS.

No. 273,491. Patented Mar. 6, 1883.



ATTEST:

C. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,

Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

REGULATOR FOR DRIVING ENGINES OF ELECTRICAL GENERATORS.

SPECIFICATION forming part of Letters Patent No. 273,491, dated March 6, 1883.

Application filed October 26, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Operating Electrical Generators, (Case No. 490,) of which the following is a specification.

In any system of electric distribution wherein dynamo or magneto electric machines feed into the same conductors or system of conductors, and are operated by two or more separate steam-engines or other motors, difficulty is experienced on account of variations in the speed of the engines.

In my application No. 488, (Serial No. 74,096,) I have shown and particularly described means for mechanically connecting the governors controlling the throttle-valves or cut-offs of all the engines, so that such governors will work together and will not be allowed to jump or vibrate independently of each other, a uniform speed of all the engines being thereby preserved.

The object of the present invention is to accomplish this end by mechanism operated or controlled electrically.

In carrying out my invention I substitute for the centrifugal governors, which are affected indirectly by the load of the engines, electrical governors, which are controlled by the current generated, and hence are affected directly by the conditions of the circuit and the load of the engines. All the governors are controlled by the current of the circuit into which the generators feed, and hence move in unison. The electrical governors are also preferably operated by the current from this circuit, although they may be operated by current from any other source.

In the preferred form of the apparatus, I connect with the throttle-valve or cut-off mechanism of each engine (the latter preferably) the spindle of an electro-dynamic motor. The circuit of these motors is controlled by an electro-magnet located in a multiple-arc circuit from the conductors with which the generators are connected, such magnet being affected exactly as are the lamps, motors, or other translating devices, which are also arranged in multiple arc. The armature lever of this magnet is provided with an adjustable retractor, and it has its central position determined by means of springs between which it is balanced. In order to avoid the use of a current-reverser, each motor has two armatures, with reverse windings or connections, one armature of each motor being brought into circuit when the armature-lever of the controlling electro-magnet makes its front contact, adjusting the throttle-valves or cut-off mechanisms of all the engines simultaneously and to the same extent in one direction, and the other armature of each motor being brought into circuit when said lever makes its back contact, adjusting the throttle-valves or cut-off mechanisms of all the engines in the opposite direction. If electro-dynamic motors with one armature each are used, a current-reverser worked by the controlling electro-magnet will be employed.

The broad invention of the electro-dynamic motor having two armatures with reverse windings will be made the subject of another application for patent.

Means are employed for cutting each motor out of circuit when the engine it governs is not running. This can be done by a switch, breaking the field-circuit of the motor and closing another circuit having a resistance equal to that of the field-magnet coils; or, the motor may be disconnected mechanically from the engine and allowed to run with the other motors.

Each generator is provided with means for varying its electro-motive force, as required, by the addition and removal of translating devices, the electrically-controlled governers being employed to adjust the engines to meet the load and to secure uniformity of speed. The means for varying the electro-motive force of each generator, as required by the addition or removal of translating devices, may be an adjustable resistance in its field-circuit.

In the accompanying drawing is shown a view of part of the cut-off mechanisms of two steam-engines, the generators driven by such engines, and means for controlling the cut-off mechanisms electrically, embodying my invention, the parts being shown separated for clearness.

A and B are two dynamo or magneto electric machines, which are connected with and feed into the same conductors, 1 2, or system of conductors. These generators are prefer-

ably connected with the conductors 1 2 in multiple arc, although they may be arranged in series or multiple series. The field-circuit 3 4 of each generator is provided with an adjustable resistance, R, to vary the electro-motive force of the machine, as required by the addition or removal of translating devices.

C D represent portions of the cut-off mechanisms of two steam-engines. The shafts *a* of the engines are coupled directly or connected by belting with the shafts of the generators, or each engine may operate two or more generators. The lever *b*, which adjusts the cut-off, is connected by a rod with a crank-pin or eccentric sleeve, *c*, on a shaft, *d*, provided with a worm-wheel engaging a worm, *e*, on the spindle of an electro-dynamic motor. Two of these motors, E F, are shown, one for each engine. Each motor has two armatures, *f g*, with reverse windings or connections, and two commutators, *h i*, the two armatures having a common field-magnet, *k*.

G is a controlling electro-magnet, located in a multiple-arc circuit, 5 6, from 1 2, and affected the same as the lamps, motors, or other translating devices H, which are also arranged in multiple arc. The armature-lever *l* of this magnet is provided with an adjustable retractor, *m*, and is centered between two springs, *n*.

The circuit of the motors is from conductor 1, by conductor 7, to the lever *l*. At the front and back contacts, *o p*, of this lever the circuit is divided, one branch, 8, passing through the armatures *f*, and the other branch, 9, through the armatures *g*. At the last machine the circuit is again through one conductor, 10, which returns through the field-magnets of all the motors, and is connected with the conductor 2. At each motor is a switch, *q*, which completes the field-magnet circuit in one position, and in its other position breaks such magnet-circuit and completes another circuit, 11, having a resistance equal to that of the field-magnet. When lever *l* makes contact *o* the armatures *f* will receive current; but when *l* makes contact *p* the armatures *g* receive the current. In a central position the lever *l* breaks both branches of the circuit through the motors. When any one of the engines is stopped, the switch *q* of the governor-motor of the engine is moved to break the field-circuit and complete circuit 11, or the motor may be disconnected mechanically from the engine.

These electrical governors, controlled from the same circuit, and that circuit the one into which all the generators feed, maintain a uniform speed of the engines, and prevent the racing of the engines, and the conversion of part of the generators into motors, which occur when the engines are controlled by separate and independent mechanisms.

What I claim is—

1. The combination, with two or more independent engines and dynamo or magneto electric machines operated thereby and feeding into the same conductors, of governors for such engines and means for electrically controlling said governors simultaneously, substantially as set forth.

2. The combination, with two or more independent engines and dynamo or magneto electric machines operated thereby and feeding into the same conductors, of governors for such engines and means connected with the circuit supplied by the generators for electrically controlling such governors simultaneously, substantially as set forth.

3. The combination, with two or more independent engines and dynamo or magneto electric machines operated thereby and feeding into the same conductors, of governors for such engines, means for operating such governors electrically, and means connected with the circuit supplied by the generators for electrically controlling such governors simultaneously, substantially as set forth.

4. The combination, with two or more independent engines and dynamo or magneto electric machines operated thereby and feeding into the same conductors, of governors for such engines, means for operating such governors electrically, energized from the same circuit, and means connected with the circuit supplied by the generators for closing reverse circuits through all of such governor-operating devices, whereby the electrical governors are caused to move in one or the other direction simultaneously, as required, substantially as set forth.

5. The combination, with the independent engines, of the motors with two armatures connected with the throttle-valves or cut-offs of the engines, and the electro-magnet controlling all of the motors, substantially as set forth.

6. The combination, with the independent engines, of the electrical governors, means for electrically controlling such governors simultaneously, and means for throwing any one of the governors out of operation without affecting the action of the other governors, substantially as set forth.

7. The combination, with two or more independent engines and dynamo or magneto electric machines operated thereby and feeding into the same conductors, of means for varying the electro-motive force of the generators, as required by the addition or removal of translating devices, and means for electrically controlling the throttle-valves or cut-off mechanisms of the engines simultaneously, substantially as set forth.

This specification signed and witnessed this 19th day of October, 1882.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
E. H. PYATT.

(No Model.)

T. A. EDISON.

SECONDARY BATTERY.

No. 273,492. Patented Mar. 6, 1883.

Fig. 1.

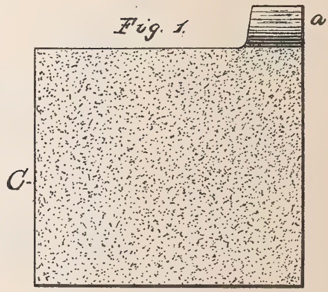


Fig. 2.

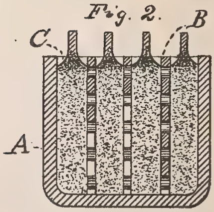
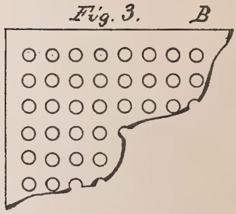


Fig. 3.



WITNESSES:

E. C. Rowland

C. P. Mott

INVENTOR:

Thomas A. Edison

BY Z. F. Wilber

ATTORNEY

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SECONDARY BATTERY.

SPECIFICATION forming part of Letters Patent No. 273,492, dated March 6, 1883.

Application filed June 26, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Secondary Batteries, (Case No. 419;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce a highly efficient form of secondary battery, employing electrodes of metallic lead of such peculiar construction that the battery will be ready for use with a far less extensive preparatory "forming" of the electrodes than is required with ordinary lead plates. This I accomplish by the employment of electrodes made entirely of finely-divided or spongy metallic lead, which is produced chemically or by electrolysis, portions of such electrodes being compressed to form connections.

In carrying out the invention the finely-divided metallic lead is packed in vertical compartments in a suitable vessel. These compartments are separated by perforated partitions, which are constructed of suitable insulating material—such as celluloid, hard rubber, cloth, mica, earthenware, or parchment paper. The finely-divided metallic lead is extended above the perforated insulating partitions at one end of each electrode, and is compressed into a solid mass for giving means for making the necessary connections. The dilute sulphuric acid is held by the perforations of the partitions and by the pores of the material of which the partitions are constructed, if a porous material is employed, and by perforating the material closely a large part of the surface of each electrode will be exposed to the action of the oxygen and hydrogen liberated in charging the battery. The spongy or finely-divided metallic lead may be obtained by any method, as by heating an organic salt of lead, or by precipitating finely-divided lead by immersing metallic iron or zinc in a solution containing a lead salt—such as the acetate of lead, or by depositing finely-divided metallic lead by the electrolysis of the acetate of lead, the deposited lead being removed and packed into the compartments as before explained.

In the accompanying drawings, forming a part hereof, Figure 1 is an elevation of one of the electrodes; Fig. 2, a vertical section of a battery constructed in accordance with my invention; and Fig. 3 a view of a portion of one of the perforated partitions.

A is a suitable vessel, which is divided into compartments by transverse partitions B. These partitions are made of a suitable insulating material, and are perforated as shown. The electrodes C are made of finely-divided metallic lead, packed into the compartments, as shown. The finely-divided metallic lead of each electrode is extended up at one end and is compressed to form the solid lug *a* to which connection is made. The electrodes of finely-divided metallic lead are retained in position and separated by the insulating partitions, in the perforations of which is held the dilute sulphuric acid.

What I claim is—

The electrodes for secondary batteries composed of finely-divided metallic lead having compressed portions for connections, substantially as set forth.

This specification signed and witnessed this 19th day of May, 1882.

THOMAS A. EDISON.

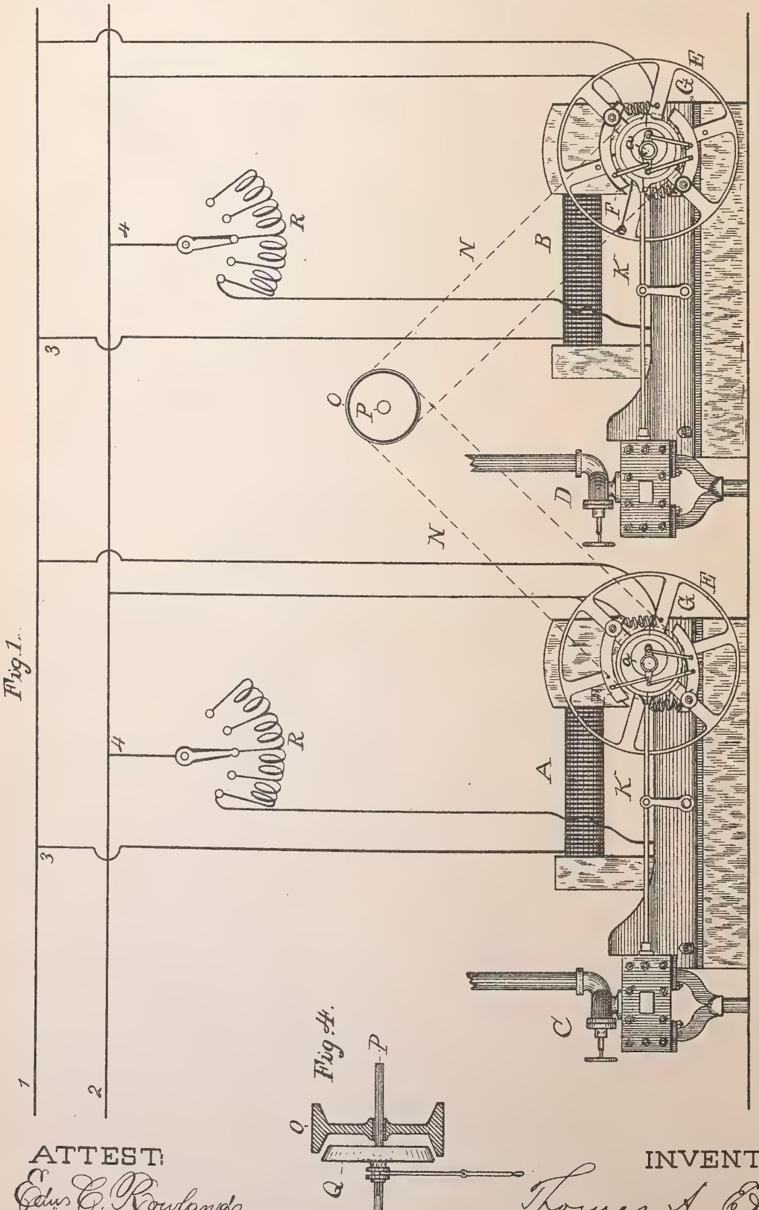
Witnesses:
EDW. C. ROWLAND,
C. P. MOTT.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

VALVE GEAR FOR ELECTRICAL GENERATOR ENGINES.

No. 273,493. Patented Mar. 6, 1883.



ATTEST:
Edw. C. Rowland
W. H. Seely

INVENTOR:
Thomas A. Edison,
By Rich^d N. Dyer
Atty.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

VALVE GEAR FOR ELECTRICAL GENERATOR ENGINES.

No. 273,493. Patented Mar. 6, 1883.

Fig. 2.

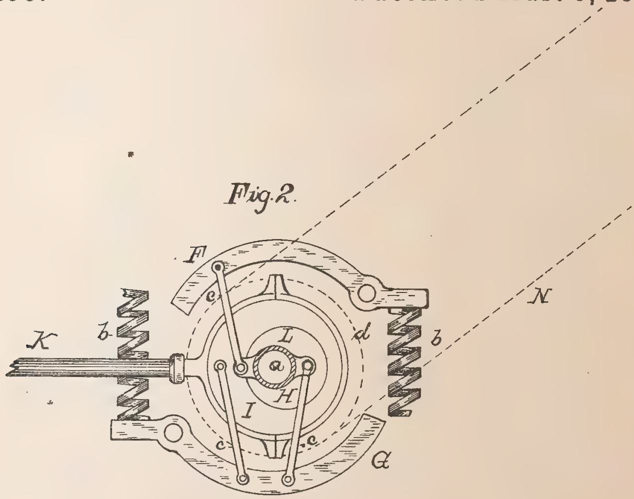
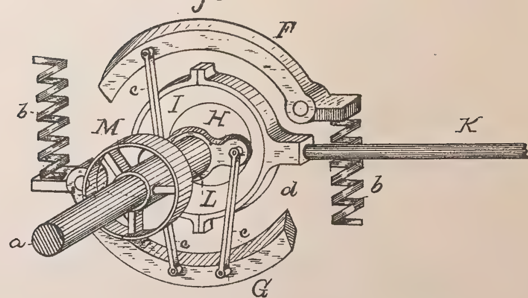


Fig. 3.



ATTEST:

Edw. D. Rowland

W. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich^d N. Dyer,

Att'y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

VALVE-GEAR FOR ELECTRICAL GENERATOR-ENGINES.

SPECIFICATION forming part of Letters Patent No. 273,493, dated March 6, 1883.

Application filed October 26, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Valve-Gear for Electrical Generator-Engines, (Case No. 500,) of which the following is a specification.

As explained in my application No. 488, (Serial No. 74,096,) great difficulty is experienced in operating two or more independent steam-engines, or other motors, running dynamo or magneto electric machines which feed into the same conductors or system of conductors, on account of the racing of the engines and the conversion of part of the generators into motors. In said application means are particularly shown and described for connecting together mechanically the governors of one type of engines. In that type the governors are mounted on spindles run from the engine-shaft and operate an arm which shifts the position of a slide-block working in a slot in a pivoted eccentric sleeve. The governor-arms being connected to a common shaft, the engines are forced to run in unison.

The object of my present invention is to produce simple and efficient means for connecting the governors of another type of engines, wherein pivoted centrifugal spring-weights are carried by the fly-wheel of each engine, and are connected with a double or single eccentric mounted loosely upon the engine-shaft. The sleeve surrounding the double or single eccentric is connected directly with the valve-rod, and the adjustment of such eccentric by the weights varies the point at which the steam is cut off. When the eccentric is double there is an adjustment of the outer part upon the inner part of the eccentric, as well as an adjustment of the inner part upon the shaft, while if the eccentric is single there is an adjustment only of the eccentric upon the shaft. The object is accomplished by connecting the loose eccentrics of all the engines together, so that variations in the governor of one engine will cause corresponding variations in the governors of all the other engines, and a uniform speed of the engines will be maintained. The connections of the eccentrics is made by any suitable means, each connection being a removable one, so that more or less of the engines can be run, as desired.

In carrying out my invention, the loose eccentric (or the inner part thereof, if it is a double eccentric) is mounted upon a sleeve loose upon the engine-shaft, which sleeve carries a pulley connected by a belt with a pulley on a revolving shaft common to all the engines; or the sleeve of the eccentric may be connected with the common shaft by gearing or otherwise. The connection with the common shaft is made a removable one by the use of a clutch-pulley, or by other means. All the eccentrics being connected with the common regulating-shaft, this shaft will be revolved by the engine-shafts, and the adjustment of one eccentric by its governor will, through the medium of the common shaft, adjust the other eccentrics simultaneously and to the same extent.

In the accompanying drawings, Figure 1 is an elevation of two engines with the governor-eccentrics connected with a common shaft, a diagram of connections being shown; Fig. 2, an elevation of one of the governors; Fig. 3, a perspective view of the same; and Fig. 4, a sectional view of a clutch forming the removable connection with the common shaft.

A and B represent dynamo or magneto electric machines which have their armatures connected to the same conductors, 1 2, or to the same system of conductors. The field-circuits 3 4 of the machines are provided with adjustable resistances R to regulate the machines, as required, by the addition and removal of translating devices.

C and D represent steam-engines, the shafts *a* of which are coupled directly with the shafts of the generators.

Upon each engine-shaft *a* is a wheel, E, which carries two pivoted weights, F G. These weights are thrown inwardly toward the shaft by springs *b*, and are connected by links *c* with the inner and outer parts, H I, of the loose eccentric. If a single eccentric is used, the links *c* will be connected with the one movable part. The eccentric sleeve *d* is connected with the valve-rod K. The eccentric, or the inner part, H, thereof, is mounted on a sleeve, L, sleeved upon the shaft *a*, and carrying a pulley, M. This pulley is connected by a belt, N, with a

loose pulley, O, on the revolving shaft P. The loose pulley O is connected with the shaft P, when desired, by a friction-clutch, Q, Fig. 4. All the engines (two or more) have their governors connected in this way with the revolving shaft P, and are thus forced to work in unison.

What I claim is—

1. The combination, with two or more separate engines having automatic cut-off mechanisms composed of loose eccentrics, and wheel-governors adjusting such eccentrics, of means for connecting such cut-off mechanisms together, so that they will work in unison, substantially as set forth.

2. The combination, with dynamo or magneto electric machines feeding into the same conductors, and two or more separate engines having automatic cut-off mechanisms composed of loose eccentrics, and wheel-governors adjusting such eccentrics, of means for connecting such cut-off mechanisms together, so that they will work in unison, substantially as set forth.

3. The combination, with two or more separate engines having automatic cut-off mechanisms composed of loose eccentrics, and wheel-governors adjusting such eccentrics, of a revolving shaft, and means connecting such shaft with the loose eccentrics of all the engines, substantially as set forth.

4. The combination, with two or more separate engines having automatic cut-off mechanisms composed of loose eccentrics, and wheel-governors adjusting such eccentrics, of a revolving shaft, means connecting such shaft with the loose eccentrics of all the engines, and means for disconnecting the engines as desired, substantially as set forth.

5. The combination, with two or more separate engines having automatic cut-off mechanisms composed of loose eccentrics, and wheel-governors adjusting such eccentrics, of sleeves upon which the eccentrics are mounted, a common revolving shaft, and pulleys and belts connecting the sleeves with said shaft, substantially as set forth.

This specification signed and witnessed this 19th day of October, 1882.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
E. H. PYATT.

(No Model.)

T. A. EDISON.

ELECTRICAL RAILROAD.

No. 273,494. Patented Mar. 6, 1883.

Fig. 1.

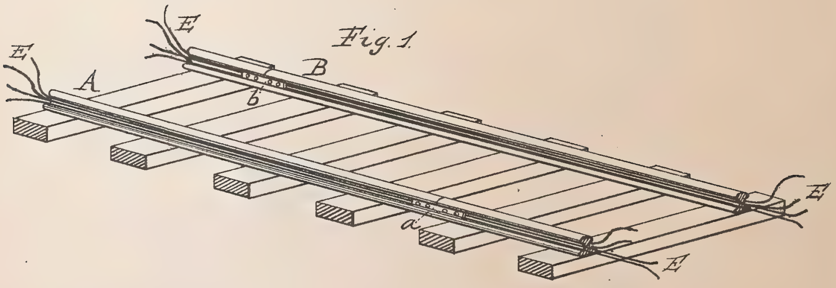
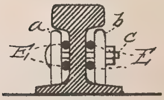


Fig. 2.



WITNESSES:

E. C. Rowland

W. W. Seely

INVENTOR:

Thomas A. Edison,
By Richd. N. Dyer,
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRICAL RAILROAD.

SPECIFICATION forming part of Letters Patent No. 273,494, dated March 6, 1883.

Application filed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Railroads, (Case No. 467;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

Heretofore in electrical railroads wherein the two lines of traffic-rails have been used as part or all of the conductors for carrying the current to and from the motor, or wherein a third or central line of rails has been used for one-half of the circuit, it has been attempted to lessen the resistance and secure good conductivity by perfecting as far as possible the joints between the ends of the rails; but this has been only partially successful, from the fact that loose joints have to be provided at the ends of the rails to permit of expansion and contraction, and the surfaces of the parts in contact becoming oxidized the contact becomes bad, making the combined resistance of the large number of joints in any section of the railroad considerable.

The object of the present invention is to reduce the resistance of the circuit to the minimum. This is accomplished by providing each line of rails used as a conductor with two or more continuous conducting-wires on one or on each side of the line of rails, which continuous wires pass beneath the fish-plates at the joints of the rails, and are clamped by such fish-plates against the rails. These wires may be bare copper wires, or they can be insulated between the fish-plates and left bare where they pass under such fish-plates. The insulation is scraped from the web of the rails at the ends, and the surfaces so scraped are cleaned, and may be electroplated with nickel or silver or other metal not easily oxidized by exposure to air and moisture, in order to make good contact with the continuous wires. One of the conductors from the electrical generators is connected with the continuous wires of the line of rails and with the rails directly or with the wires only. It will be seen that the resistance of the lines of rails provided with the continuous conducting-wires will be greatly reduced thereby, since the wires will form a continuous metallic circuit to and from the rails over which the motor is passing, no matter where the motor may be on the track, more or less of the current being conducted through the lines of rails according to the resistance at the joints.

In the drawings, Figure 1 is a perspective view of a portion of two lines of rails having the continuous conducting-wires; and Fig. 2, a cross-section of a rail near the end of the same, showing the fish-plates in elevation.

A and B represent two lines of T-rails. The rails of each line are connected together by fish-plates *a b* and bolts *c*, passing through the fish-plates and rails, as usual. The rails are used as conductors of the current, and are insulated as described in my application No. 466.

E represents continuous conducting-wires, which are placed on one or on each side of the rails of each line, and are clamped by the fish-plates against the ends of the rails. The continuous wire may be bare copper wire, or it can be insulated, except where it passes beneath the fish-plates. The webs of the rails at their ends have the insulation removed therefrom, and are cleaned and preferably electroplated with nickel, silver, or other metal not easily oxidized by exposure to air and moisture, in order to make as good contact as possible with the continuous wires. The conductors from the electrical generators are connected with the wires and also with the rails or with the wires alone. The current is conducted to and from the motor through wheels resting on the rails, and a continuous metallic circuit will be formed to and from the rails over which the motor is passing by the conducting-wires, while part of the current will pass through the rails themselves.

What I claim is—

1. In an electrical railroad, a line of connected rails having its conductivity increased by means of one or more continuous conductors attached thereto, substantially as set forth.

2. In an electrical railroad, the combination, with a line of connected rails, of one or more

continuous conductors attached to such rails and making contact therewith at the joints of the rails, substantially as set forth.

3. In an electrical railroad, the combination, with a line of connected rails, of one or more continuous conductors extending on one or on each side of the rails and clamped by means of the fish-plates against the ends of the rails with which they make electrical contact, substantially as set forth.

This specification signed and witnessed this 7th day of July, 1882.

THOMAS A. EDISON.

Witnesses:

RICHD. N. DYER,

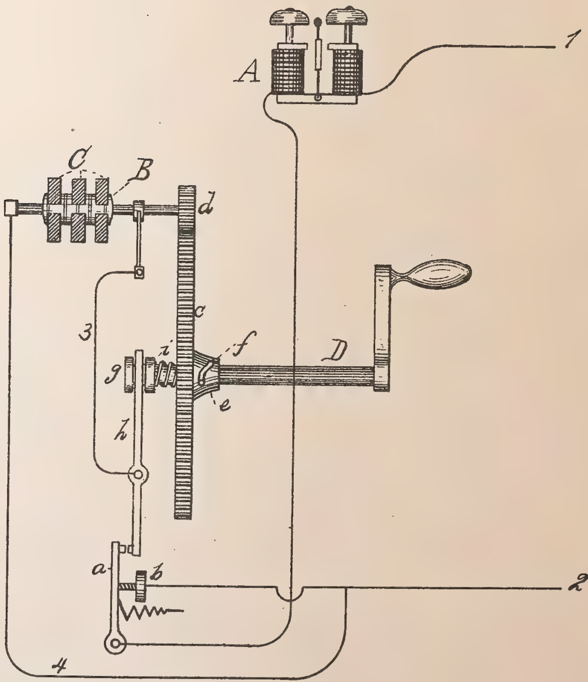
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

MAGNETO ELECTRIC SIGNALING APPARATUS.

No. 273,714. Patented Mar. 13, 1883.



WITNESSES:

E. C. Rowland,

H. W. Seely.

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer, Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MAGNETO-ELECTRIC SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 273,714, dated March 13, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Magneto-Electric Signaling Apparatus, (Case No. 469,) of which the following is a specification.

Heretofore in magneto-electric signaling apparatus it has been usual to provide means for normally closing a short or shunt circuit around the dynamo or magneto electric machine, and for automatically breaking such shunt-circuit immediately upon and continuously during the operation of the machine, the generator-circuit being kept permanently closed, as described in my application filed September 19, 1881, the purpose being to cut out of circuit the resistance of the generator when not in use by providing a circuit of practically no resistance around it, and to throw the generator into circuit when in use by breaking this shunt-circuit, the whole being done automatically by utilizing the mechanical movement necessary to work the generator.

The object of the present invention is to provide simple and efficient means for automatically throwing the generator into and out of circuit, not dependent upon the making and breaking of a shunt-circuit while the generator-circuit is kept closed. This is accomplished by providing means for automatically closing the main line and opening the generator-circuit when the generator is not in use, and for automatically opening the main line and closing the generator-circuit when the generator is in use.

In carrying out the invention the movement of the crank or wheel in working the generator is utilized to move a lever in one direction, such lever being moved in the other direction by a spring. This lever, when moved by the working of the generator, makes contact with a spring-lever, and separates the same from a contact-point. The main line passes through the latter lever and its contact-point, and hence their separation opens the main line. The first lever is connected with one end of the generator-circuit, while its other end is connected with the main line at or beyond the contact-point of the second lever. When the first lever pushes the second lever from its contact-point the generator-circuit is completed by the contact of the levers, and the generator will throw electric impulses upon the main line, the two levers forming a switch which is worked by the movement required to operate the generator.

In utilizing the movement of the crank-shaft a sleeve may be moved longitudinally on the shaft by the force of turning the crank; but I prefer to move the shaft itself, it being connected with the cog or belt wheel, through which it passes loosely by a pin working in an oblique or triangular slot in the hub of such wheel. The shaft is provided with a grooved collar to work the lever, and is moved longitudinally in one direction by a spring.

The foregoing will be better understood from the accompanying drawing, which illustrates, partly diagrammatically, apparatus embodying the invention.

1 2 represent the main line passing through the coils of the bell-magnet A, and through the spring-lever *a* and contact-point *b*, the conductor 1 being connected with the lever *a*, while the conductor 2 is connected with the contact-point *b*.

B is the revolving armature of a dynamo or magneto electric machine, the field-magnets C of which are shown in horizontal section. The armature is revolved by crank-shaft D through cog-wheels *c d*, or two grooved wheels connected by an endless belt. The shaft D passes loosely through the hub of wheel *c*, and is connected therewith by a pin, *e*, entering an oblique slot, *f*, in the hub of said wheel. Shaft D has a grooved collar, *g*, at its inner end, which receives the end of a pivoted lever, *h*. A spiral spring, *i*, moves the shaft D in one direction longitudinally, while it is moved in the opposite direction by the traveling of the pin *e* in the oblique slot *f*. The generator-circuit 3 4 is connected with the lever *h* and with the contact-point *b* or the conductor 2 beyond said contact-point. Normally when the generator is not in use the main line will be closed at *b*, and the generator-circuit will be open, levers *a* and *h* not being in contact. When the crank-shaft D is turned the shaft will move longitudinally, and lever *h* will strike lever *a*, forcing it from contact *b* and keeping it separated therefrom until the movement is stopped,

when it will make contact again with b. This movement of lever h, forcing a from b, completes the generator-circuit at the same time that it opens the main line.

What I claim is—

1. In magneto-electric signaling apparatus, the combination, with a dynamo or magneto electric machine, of means for automatically opening the main line and closing the generator-circuit when the generator is in use, and for automatically closing the main line and opening the generator-circuit when the generator is not in use, substantially as set forth.

2. In magneto-electric signaling apparatus, the combination, with a dynamo or magneto electric machine, of a switch operated automatically by the movement required to work the generator, and the main line and generator circuits made and broken alternately by the switch, one circuit being open when the other is closed, substantially as set forth.

3. In magneto-electric signaling apparatus, the combination, with a dynamo or magneto electric machine, of the lever a and contact b, connected with the main line 1 2, the lever h, worked by the movement required to operate the generator, and the generator-circuit 3 4, connected with h and with 2, the main line being normally closed at b, and the generator-circuit being normally open by the separation of a and h, substantially as set forth.

4. In magneto-electric signaling apparatus, the combination, with the dynamo or magneto electric machine, of a longitudinally-moving driving-shaft, and means operated by the movement for throwing the generator into and out of circuit, substantially as set forth.

This specification signed and witnessed this 5th day of August, 1882.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ART OF MALLEABLEIZING IRON.

SPECIFICATION forming part of Letters Patent No. 273,715, dated March 13, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Art of Malleableizing Cast-Iron; and I do hereby declare that the following is a full and exact description of the same.

My invention relates to the art of rendering cast-iron malleable; and it consists in a new and improved process or method of decarbonizing articles made of cast-iron to the extent necessary to give to the iron the desired degree of malleability.

This improved process or method may be stated in general terms as consisting in removing from the iron by exhaustion and while at a high heat as large a per cent. as possible of the air or gases occluded within its pores, and then replacing such air or gases with an active carbon-reducing agent, to the end that the carbon be speedily eliminated, it uniting with the reducing agent to form a gaseous compound.

In carrying this process into practice I prefer to proceed as follows: The iron article or articles to be rendered malleable are placed in a pot or flask capable of standing a high degree of heat and provided with a connection to an air-pump, so that the air may be exhausted therefrom, and also provided with a connection to a source of supply of a reducing-gas. The pot or flask is also so constructed that it may be closed air-tight. The article or articles are placed in the pot or flask, which is then closed air-tight and subjected to heat sufficient to bring the articles to a white or nearly white heat, whereupon the air is exhausted by the pump from the pot or flask to as great a degree as is readily attainable, the same degree of vacuum of course existing within the pores of the iron. A charge of the active reducing agent chosen in a gaseous state is then admitted to the pot or flask, replacing the extracted gas or air in the pores of the iron, thereby being brought into intimate contact with the carbon and eliminating it by combustion in whole or in part. With very small articles the one exhaustion and one charging so far described might suffice. In practice, however, it is preferable to again exhaust the pot or flask and again charge with the reducing agent and to repeat this sequence of operations until proper malleableization is attained, the heat being kept up constantly during the operations. Good and speedy results are had by using as the carbon-reducing agent oxygen or an oxidizing-gas, which under some conditions may be common air.

The operation of the process may be stated as follows, supposing for the sake of illustrating that an oxidizing agent be employed: The heating opens more freely the physical and mechanical pores of the cast-iron, exposing more fully the carbon in the iron for the action of the agent, while at the same time it tends to expel therefrom a part of the air or other occluded gas, if such there be, by rarefying it. The exhaustion almost completely empties these pores, leaving them in condition to be filled by any gaseous matter presented. On the charge being admitted, it fills them, the oxygen unites with the carbon immediately, in view to form carbonic oxide or acid, which tends to remain in the pores. If the process stopped here, it would so remain, except as displaced by the further diffusion of the oxidizing agent—a slow process. Therefore the pot or flask is again exhausted, and a fresh charge admitted. The results are that cast-iron is rendered malleable in a very short time, the time of treatment being at the most only hours where days are required with the old processes, the malleableization being more thorough and at less cost. After the proper degree of malleability has been attained it is preferable that the articles should for a few minutes be raised to a higher degree of heat than that used during the process.

What I claim is—

1. The improvement in the art of rendering solid cast-iron malleable, which consists in heating the iron to a high heat, then exhausting mechanically any air or occluded gas therefrom, and then charging the iron with an active carbon-reducing agent in gaseous form, substantially as set forth.

2. The improved process of treating solid cast-iron to render it malleable, consisting in inclosing it in an air-tight pot or flask, heating the cast-iron therein, exhausting the air therefrom, and then charging the same with

an active carbon-reducing agent in gaseous form, substantially as set forth.

3. The improved process of treating solid cast-iron to render it malleable, consisting in inclosing it in an air-tight pot or flask, heating the cast-iron therein, exhausting the flask and then charging the same with an active carbon-reducing agent in gaseous form, again exhausting and charging, the two latter operations being repeated as often as necessary, the cast-iron being meanwhile maintained at a high heat, substantially as set forth.

This specification signed and witnessed this 4th day of October, 1881.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

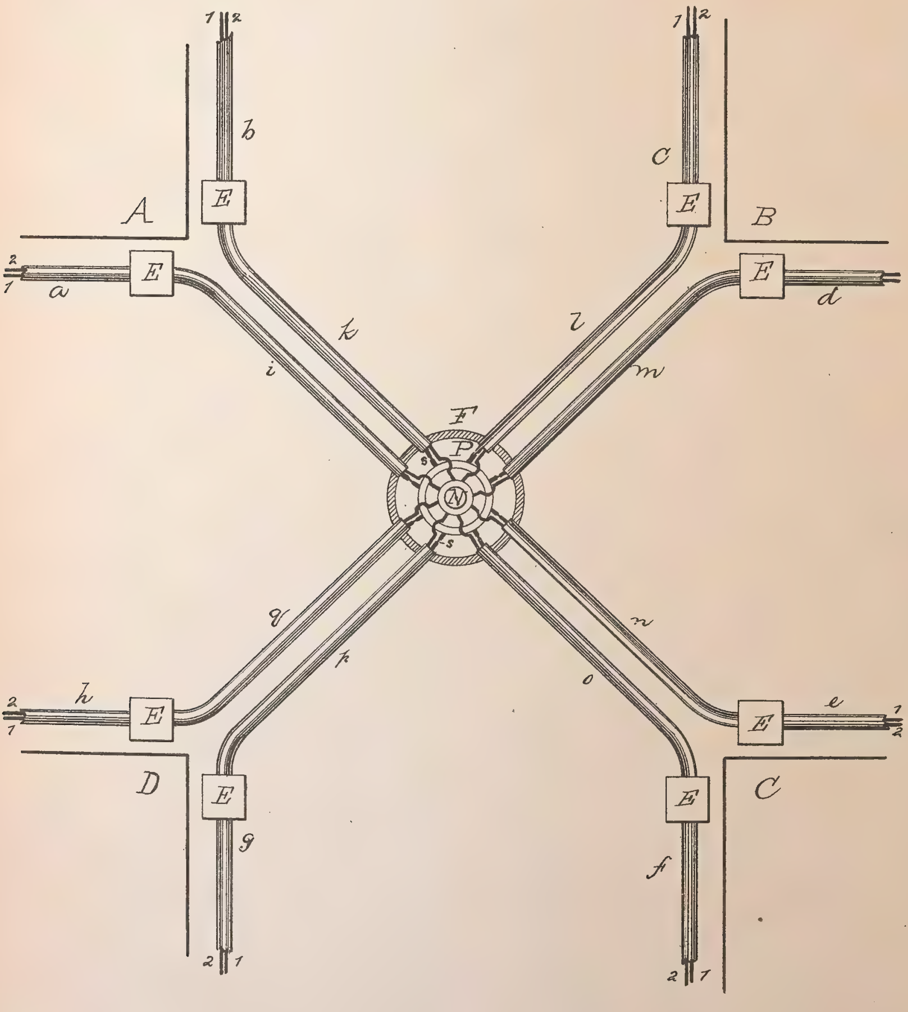
RICHD. A. DYER.

(No Model.)

T. A. EDISON.

SYSTEM OF UNDERGROUND CONDUCTORS FOR ELECTRICAL DISTRIBUTION.

No. 273,828. Patented Mar. 13, 1883.



WITNESSES:
E. C. Rowland
H. W. Seely

INVENTOR:
T. A. Edison
BY Rich^d N. Dyer,
ATTORNEY.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SYSTEM OF UNDERGROUND CONDUCTORS FOR ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 273,828, dated March 13, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Underground Conductors for Electrical Distribution, (Case No. 421;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

I have proposed heretofore, in laying the conductors for my multiple-arc system of electrical distribution, to connect the intersecting conductors at each crossing of two streets at four points by running them into four junction-boxes located at the corners of the blocks or squares, the positive conductors being in this way all connected together, and likewise all the negative conductors, the whole forming a double net-work of intersecting and connected conductors. Each tube was run into a separate box near each corner, and a fusible conductor or "safety-catch" placed in the line of one or each conductor. This plan is set forth in application for patent filed by me October 4, 1881, (Serial No. 43,162.)

The object of the present arrangement is to produce a more convenient manner of arranging and connecting the conductors at the intersection of two streets, making them more accessible for repairs of connections, replacement of safety-catches, or for testing purposes. This I accomplish by connecting the conductors of the eight pairs of conductors at each street intersection and locating the safety-catches at one point. For this purpose the eight tubes carrying the conductors are run to the center of the street intersection, and there enter a single box in which the positive conductors are connected together, as well as the negative conductors, and in which a fusible conductor or safety-catch is placed in the line of each of the positive or negative conductors, or both. This box is provided with a hand-hole and cover at the surface of the pavement for giving easy access to the connections. A similar method of connecting the conductors may, if desired, be employed where one street runs into another without crossing, in which case only six tubes instead of eight would enter the box.

The foregoing will be better understood from the drawing, which is a top view of the parts, the junction-box being in horizontal section.

A B C D are four blocks or squares, along the sides of which run the tubes *a b c d e f g h*, each carrying a pair of conductors, 1 2. From coupling or service boxes E, near corners of the blocks or squares, tubes *i k l m n o p q* run to a box, F, at the center of the intersection of the streets, such tubes being bent to the proper curve for the purpose, which bending does not affect the insulation of the inclosed conductors. The tubes enter the sides of the box F, and the conductors projecting from such tubes are connected to rings or plates P N. Safety-catches or sections of fusible conductor *s* are connected in the line of the positive or negative conductors, or both, within the box F, which safety-catches melt and break the circuit when the flow of current becomes abnormal and before damage is done. The junction-box F has a hand-hole and cover at the surface of the pavement, to give access to the connections.

What I claim is—

1. In a system of underground conductors for electrical distribution, the combination of positive and negative conductors forming complete metallic circuits, laid on opposite sides of intersecting streets, with connections between all the positive conductors and connections between all the negative conductors of the two streets, said connections being made at one point, to which all the conductors run, substantially as set forth.

2. In a system of underground conductors for electrical distribution, the combination of positive and negative conductors, laid in intersecting streets and forming complete metallic circuits, with connections between all of the positive conductors and connections between all the negative conductors of the two streets, said connections being made at one

point, to which all the conductors run, and fusible safety-catches in the several circuits at such point, substantially as set forth.

3. The combination, with the tubes laid on each side of intersecting streets and the pairs of conductors inclosed therein, of a single central box, into which all of such tubes run, and two pole-plates within such central box, to which all the conductors are connected, substantially as set forth.

This specification signed and witnessed this 22d day of May, 1882.

THOMAS A. EDISON.

Witnesses:

EDWARD C. ROWLAND,

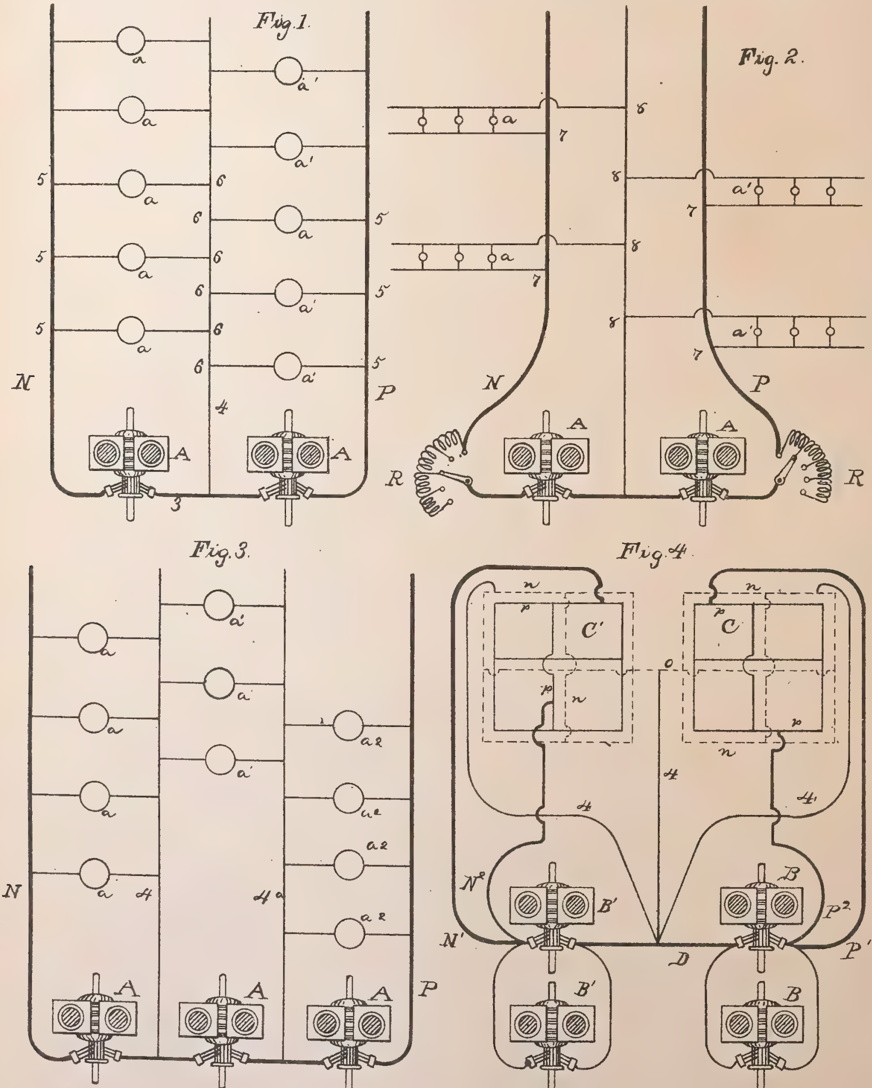
C. P. MOTT.

(No Model.) 3 Sheets—Sheet 1.

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 274,290. Patented Mar. 20, 1883.



ATTEST:

E. C. Rowland.

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer, Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 3 Sheets—Sheet 2.

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 274,290. Patented Mar. 20, 1883.

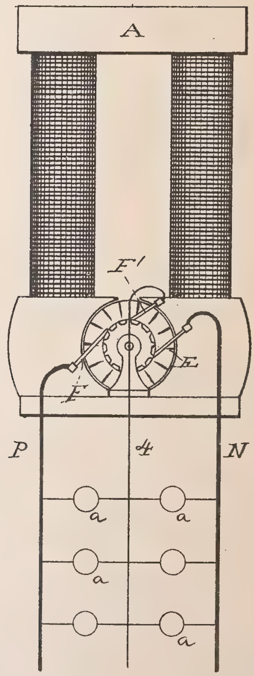


Fig 5.

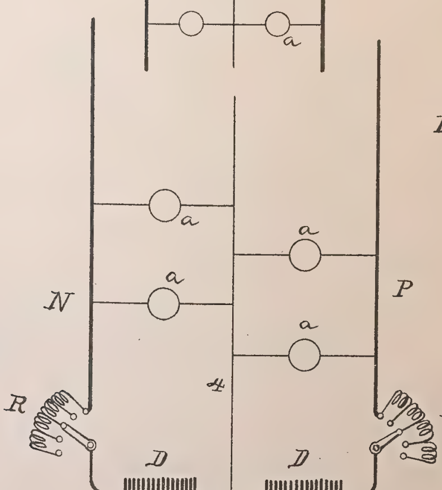


Fig. 6.

WITNESSES:

E. C. Rowland

W. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,

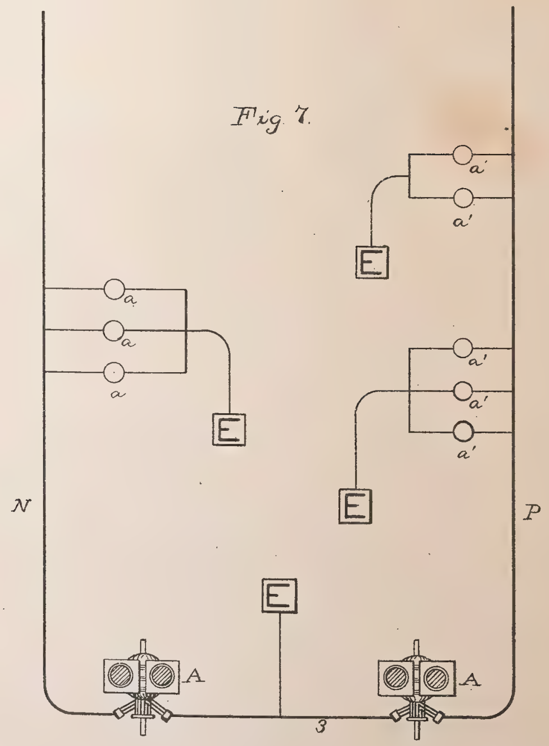
Atty.

(No Model.) 3 Sheets—Sheet 3.

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 274,290. Patented Mar. 20, 1883.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd N. Dyer,

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 274,290, dated March 20, 1883.

Application filed November 27, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electrical Distribution, (Case No. 520,) of which the following is a specification.

In multiple-arc systems of lighting by electrical incandescence in which complete or round metallic circuits are used it may sometimes be desired to employ electric currents of unusually high electro-motive force, so that the size of the conductors which convey said current may be diminished, thus economizing in metal, and allowing the conductors to be placed overhead instead of laid under ground in places where the former arrangement is more convenient. It is also generally desirable in such systems that the incandescing electric lamps or other translating devices should be independent of each other—that is, that such devices shall be independently controllable, so that each lamp can be lighted and extinguished separately and without affecting any others.

To provide a system in which currents of high tension can be used, while at the same time each lamp is entirely independent of all the others, the lamps being also each of the standard or usual resistance, is the object of my invention; and I accomplish this by employing a source of energy of high electro-motive force, arranging the translating devices in multiple series, dividing said source into as many parts as there are translating devices in series in any circuit, and correspondingly dividing each series of lamps, such division being made by means of a central compensating conductor or conductors connected between the divisions of the source of energy, and also between the translating devices, so that when all the devices in any multiple-arc circuit are in use current will pass through all such devices, the current passing across from the positive to the negative main conductor; but if one or more translating devices are removed from any series circuit the excess of current which would otherwise affect the other lamps in the circuit is taken by the compensating central conductor, so that the other lamps remain unchanged. The compensating-conductor is preferably a metallic wire, though the earth might be used for the purpose, if it is so desired.

In carrying out my invention the central station or source of electrical supply for the system may contain one, two, or any desired number of generators, according to the number of translating devices to be supplied with current, such generators developing a high electro-motive force. Such generators are preferably dynamo or magneto electric machines; but secondary batteries may be employed, if desired, and the generators may be connected in any desired manner. If two generators, placed in series, are employed, the compensating-conductor is connected between the two to the wire connecting their armatures, such compensating-conductor extending out between the two main conductors leading from the generators. The multiple-arc circuits which contain the lamps or other translating devices extend across from each main conductor to the compensating-conductor. When equal numbers of lamps are in circuit on opposite sides of the compensating-conductor, no current will traverse such compensating-conductor, the whole amount generated passing out through the positive main conductor across both sets of multiple-arc circuits containing lamps, and back by the negative main conductor, as will be more fully hereinafter explained. Thus the same effect is produced as though two lamps were in series in each multiple-arc circuit, as the current must pass through two lamps to get from the positive to the negative conductor. At the same time, however, such two lamps are independently controllable.

In case lamps are removed from one side of the compensating-conductor, so that the numbers on opposite sides become unequal, a portion of current varying in amount according to the degree of inequality will pass through the compensating-conductor, the direction of such current varying according to whether the positive or the negative side contains the greater number of devices. The system should be so arranged by properly locating the lamps and conductors that at no time can there be a very great inequality between the two sets of lamps. Thus very little current will ever traverse the compensating-conductor, almost the whole passing out through the positive and re-

turning by means of the negative main conductor. The compensating-conductor can therefore be of very small mass, it never being required to convey much current. An adjustable resistance is preferably placed in each main conductor, so that in case the drop in electro-motive force is greater on one main conductor than on the other the resistance may be adjusted to compensate for such inequality. In systems of general distribution such resistances would be placed in the conductors of the feeding-circuits.

It is evident that two or more generators may be placed on each side of the central conductor in series or in multiple arc, if desired.

If currents are to be employed of such high tension that three or more lamps must be placed in each cross-circuit between the positive and negative sides of the main circuit, three or more generators or series of generators may be placed in series, with two or more compensating-conductors extending between the main conductors, such compensating-conductors being connected between the generators or series of generators, the source of energy being thus divided into as many parts as there are lamps in series.

By the use of my invention lamps in different districts connected with separate central stations may be connected in series with each other, the generators of the two stations being connected by a conductor, and compensating-conductors running from convenient parts of the district.

If desired, one generator only might be placed at the central station, having its commutator provided with an extra brush or brushes, placed between the main brushes, from which the compensating conductor or conductors run, such conductors being connected with the multiple-arc circuits between the lamps.

My invention is illustrated in the annexed drawings, in which Figure 1 is a diagram showing an arrangement of two generators in series. Fig. 2 represents a similar arrangement of generators, but a different one of the translating devices. Fig. 3 shows the arrangement of three generators in series. Fig. 4 shows an arrangement whereby lamps in different districts, supplied from separate stations, may be placed in series. Fig. 5 shows the arrangement where one generator is used. Fig. 6 illustrates the use of secondary batteries, and Fig. 7 shows the use of the earth as a compensating-conductor.

In Fig. 1, A A represent dynamo or magneto electric machines connected in series by conductor 3, and having positive and negative main conductors P N extending from them. Midway between the generators the compensating-conductor 4 is attached to conductor 3. Multiple-arc circuits 5 6 extend from the compensating-conductor to each of the main conductors, and each of such multiple-arc circuits contains a lamp or other translating device, those on one side of the compensating-conductor being designated by a, and those on the other by a'. When, as shown, the number of lamps a is equal to that of lamps a', any current which may tend to return through conductor 4 will be neutralized by the current which will meet it from wire 3, so that no current will pass in either direction in said conductor 4; but if a lamp, a', is removed from circuit, so that less current will pass from conductor P to conductor 4, the tendency from wire 3 to wire 4 will be correspondingly greater than the return tendency, and current due to the inequality will flow in wire 4, which will pass through the lamps a and return through conductor N, while if a lamp or lamps, a, be removed, so that less current will pass from 4 to N, the difference of current will return through conductor 4. Thus the conductor 4 compensates for differences in either side; and while the lamps are independently controllable and any lamp can be removed from circuit without varying the current flowing to the lamps on the opposite side, yet it is evident that currents may be employed of as high tension as though the lamps were arranged in multiple series in the ordinary way.

The arrangement shown in Fig. 2 is similar to that just described, except that here the lamps a and a' are placed across multiple-arc circuits 7 8, derived from the main conductor P N. The same effect is of course produced as just described. The adjustable resistances R R are shown in this figure, which are used to compensate for differences in the drop in electro-motive force of the two conductors.

In Fig. 3 three generators, A A A, are shown in series, there being two compensating-conductors, 4 and 4^a, and three sets of lamps, a a' a^2, the main portion of the current passing entirely across from conductor P to conductor N, and an amount due to differences in the number of translating devices will return through the central conductors. The number of lamps a^2 being greater than a', a portion of current due to the difference will return through conductor 4^a, the remainder passing through lamps a' to conductor 4. The number of lamps a being greater than a', current will flow from the generators through conductor 4 to supply lamps a, which current will return through main conductor N.

In Fig. 4, C and C′ each represent a district to be supplied with electric energy, a central station or source of supply being provided for each district. At one central station generators B B are placed in multiple arc, and at the other generators B′ B′ are similarly arranged. It is desired to connect lamps in district C in series with lamps in district C′. To accomplish this a conductor, D, is run from one station to the other, connecting one pole of each battery of generators together. From the other poles run the feeding-circuits P′ N′ and P^2 N^2, such feeding-circuits being connected with the main conductors of the system. Compensating-conductors 4 are connected at convenient points to said main conductors, all such compensating-conductors being connect-

ed at the same point to the wire D between the stations, so that a divided source of electric energy is formed, as in the previous cases. Current flows through feeding-conductors P' P^2 to main conductors *p p*, thence through cross-circuits containing translating devices to main conductors *n n*, by a conductor, *o*, to district C', through translating devices to main conductors *p*, and back to the generators by feeders N' N^2. It is evident that each translating device in district C is in series with one in district C', though all such devices are independently controllable, the conductors 4 acting to compensate for the removal of any device on either side. It is evident that any desired number of districts might be connected in this manner by proportionately dividing the source of energy, so that currents of very high electro-motive force may be employed. Fig. 5 illustrates the application of my invention to a single generator, A, of high electro-motive force.

The main current is taken from the machine by the commutator-brushes F F, to which are connected the main conductors P N, and an extra brush, F', is provided between the main brushes, from which runs the compensating-conductor 4. Lamps *a* are arranged as in Fig. 1. The current taken by the extra brush neutralizes the tendency for current to return on the compensating-wire, so that no current traverses that wire so long as the number of translating devices remains the same on each side of the same, while as the numbers vary, current traverses such conductors in one or the other direction, as previously explained.

It is evident that the generator may be still further divided by the use of a greater number of extra brushes and compensating-conductors.

In Fig. 6, D D are secondary batteries, P N being the main conductors, and 4 the central conductor. R R are the adjustable resistances, for the purpose before described. It is evident that with either of the forms described the adjustable resistances R R may or may not be used, as found necessary.

Fig. 7 illustrates the use of the earth as a compensating-conductor, which arrangement may be convenient in some cases, though I usually prefer to use a metallic conductor.

The generators A A are connected by wire 3 in series, and conductors P N extend from them. Translating devices *a'* are connected with conductor P, and also to earth E, and translating devices *a*, connected to conductor N, are also connected to earth. Between the generators A A wire 3 is connected to earth, as shown. It will readily be seen that current will pass through the earth from P to N, and thus through both sets of translating devices in multiple series. An amount of current due to the inequality between the devices *a* and *a'* will, it is evident, pass between wire 3 and the translating devices through the earth in the same manner as explained with reference to the metallic conductor 4 of Fig. 1.

What I claim is—

1. In a system of electrical distribution having translating devices arranged in multiple series, the compensating conductor or conductors connecting the translation-circuits with the source of energy, substantially as and for the purpose set forth.

2. A system of electrical distribution having in combination the following elements, viz: a divided source of electrical energy, main conductors extending therefrom, translating devices arranged in multiple series, and a compensating conductor or conductors connecting the translation-circuits with the source of energy at the points of division, substantially as and for the purpose set forth.

3. In a system of electrical distribution, the combination, with translating devices arranged in series across main conductors, of a source of electric energy divided into as many parts as there are lamps in series, and a compensating conductor or conductors connected between the divisions of the source of energy and between the lamps in series, substantially as set forth.

4. The combination, with a source of electrical energy, of main conductors leading therefrom, translating devices in circuit from said main conductors, a compensating-conductor, and an adjustable resistance in each of said main conductors, substantially as set forth.

This specification signed and witnessed this 20th day of November, 1882.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

MOLD FOR CARBONIZING.

No. 274,291. Patented Mar. 20, 1883.

Fig. 1.

Fig. 2.

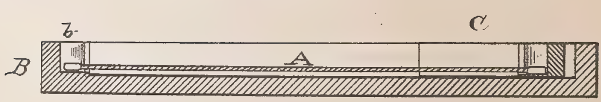
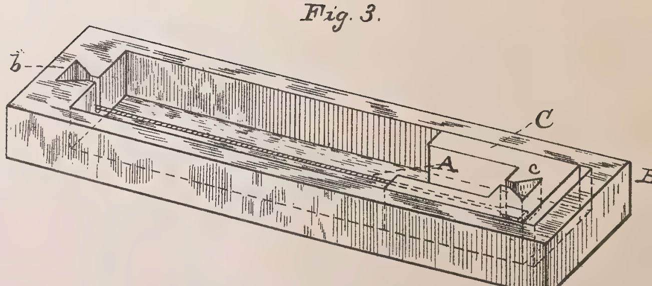


Fig. 3.



ATTEST:

Edw. C. Rowlands

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,

Atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MOLD FOR CARBONIZING.

SPECIFICATION forming part of Letters Patent No. 274,291, dated March 20, 1883.

Application filed December 8, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Molds for Carbonizing, (Case No. 528,) of which the following is a specification.

In my application No. 515 (Serial No. 77,525) is described an incandescing conductor for electric lamps, formed of a number of fine filaments twisted or otherwise massed together, and having their ends secured by a carbonizable substance.

My present invention relates to the manufacture of such conductors, my object being to provide a mold for holding them during carbonization, which will keep them straight, allow contraction, and prevent the filaments, from untwisting.

While my invention is adapted for use with the twisted filaments described, it may also be employed in carbonizing any straight filaments for the purpose mentioned.

My invention is illustrated in the annexed drawings, in which Figure 1 is an enlarged view of a twisted conductor; Fig. 2, a sectional view of the carbonizing-mold, and Fig. 3 a perspective view of the same.

The conductor A is formed of a number of fine continuous filaments massed together. Such filaments are preferably natural vegetable fibers; but they may be formed of cellulose, paper, parchment, or of fibrous material treated with hydrofluoric acid, or of any desirable carbonizable substance. The ends are secured and enlarged by the addition of a plastic carbonizable material, *a a*.

The carbonizing-mold consists of a box, B, formed of carbon, nickel, or other material capable of withstanding high temperatures. In one end is formed a slot, *b*, of such size and shape as to receive the enlarged end of the filament. At the other end of the mold is set a movable block, C, provided with a slot, *c*, similar to slot *b*. The block C may be of carbon or of nickel, or of nickel covered with carbon. It must, however, have sufficient weight to keep the filament stretched. The slots *b c* do not extend quite to the bottom of the mold, and the filament for carbonization is placed in the mold from above, with the ends resting in the bottoms of the slots and its body kept out of contact with the mold. The filament is kept taut in the mold, which is placed in the carbonizing-furnace, a suitable cover being provided. As the filament contracts the movable block C slides toward the center of the mold, keeping the filament still slightly stretched and preventing the fibers from untwisting.

It is evident that two movable blocks, instead of one, might be employed, which would slide toward each other as the carbon contracts.

It is evident that the mold described can be used for any straight filaments to allow contraction during the carbonization. Filaments formed in this manner are preferably bent into a loop before being placed in the lamp.

Any desired number of filaments may of course be placed one above another in the carbonizing-mold.

In my Patents Nos. 263,139 and 263,144 I have shown and described means for holding a filament in a doubled or looped form, under strain, during carbonization and permitting contraction, the invention herein being limited to the carbonization of straight filaments.

What I claim is—

1. The combination, with a mold for carbonizing filaments, of means for keeping such filaments straight and under strain, and at the same time allowing contraction during carbonization, substantially as set forth.

2. The combination, with a mold for carbonizing straight filaments, of means for holding both ends of a filament fixed, but allowing contraction of the filament, substantially as set forth.

3. The combination, with a mold for carbonizing straight filaments, of one or two movable blocks for holding one or both ends of the filament movably to allow contraction, substantially as set forth.

4. A mold for carbonizing straight filaments, provided with a slot for holding an end of the filament, and a movable block having a similar slot for the other end of the filament, substantially as set forth.

5. The method of manufacturing incandescing conductors for electric lamps, consisting in twisting together a number of fine filaments of carbonizable material, securing their ends, and then carbonizing the whole while under tensile strain, substantially as set forth.

This specification signed and witnessed this 28th day of November, 1882.

THOS. A. EDISON.

Witnesses:

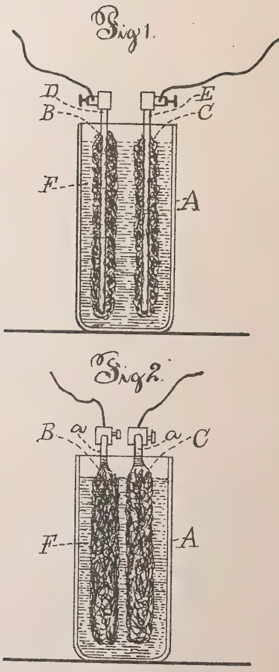
H. W. SEELY,
E. H. PYATT.

(No Model.)

T. A. EDISON.

SECONDARY BATTERY.

No. 274,292. Patented Mar. 20, 1883.



WITNESSES:

E. C. Rowland,

H. W. Seely

INVENTOR:

T. A. Edison by

Rich. N. Dyer

Atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SECONDARY BATTERY.

SPECIFICATION forming part of Letters Patent No. 274,292, dated March 20, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Secondary Batteries, (Case No. 439;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

Heretofore in secondary batteries the electrodes have been formed of lead plates, or lead plates having oxide of lead secured thereto, or of lead plates carrying chemically-precipitated metallic lead; but all these constructions have defects which detract greatly from their efficiency. The simple lead plates present a very small surface, and hence have a low efficiency, and, in addition, it becomes necessary, for that reason, to reduce the surface of the plates to oxide to a considerable depth. This thick coat of oxide cracks off and separates at points from the plates, producing bad contact and high resistance, and making portions of the oxide inert and reducing greatly the efficiency of the battery. With the second construction—that of the oxide secured to lead plates—the oxide also becomes separated from the lead plates, resulting in bad contact, high resistance, inert portions, and loss of energy. The spongy or chemically-precipitated lead carried by lead plates is also open to the same objection, the precipitated lead not being integral with the plates which carry it or the particles of the lead with one another, and becoming detached from such plates in use.

The object, therefore, that I have in view is to produce electrodes of metallic lead for secondary batteries without the use of chemically-precipitated lead or salts or compounds of lead, which electrodes will be integral throughout and will present an exceedingly large surface, producing a highly efficient battery by a small reduction of the surface of the lead, and not having the defects before stated. This I accomplish by constructing each electrode, or the exposed surface thereof, of integral arborescent metallic lead. This form of lead is obtained by pouring molten lead from a height into water or into powdered material—such as powdered chalk or lime—or by blowing air through molten lead. The crystallization of the lead being disturbed at the moment of setting, the lead assumes an arborescent form, presenting a large surface and being integral throughout its mass. This integral arborescent lead may be fused to lead plates by fusing the surfaces of the plates and pressing the arborescent lead upon them. The arborescent lead is thus made integral with the plates which carry it, the plates forming means for making connection; or molten lead may be blown onto lead plates in dropping from a height, and will be fused with the plates and assume upon them the arborescent form. The electrodes are, however, preferably made entirely of arborescent metallic lead, and they may be so constructed by pouring molten lead into suitably-shaped troughs or receptacles containing water. The arborescent lead will take the shape of the troughs, and lugs for making connections may be formed by pinching or fusing the arborescent lead together. This form of electrodes has openings entirely through it, and has the advantage, in a battery, of bringing the back sides of the outer electrodes into action, increasing the efficiency of the battery.

In the drawings, Figure 1 is a vertical section of a secondary cell having the electrodes made partly of integral arborescent metallic lead; Fig. 2, a similar view of a secondary cell having the electrodes made entirely of such lead.

A is the containing-vessel. B C are the electrodes, made entirely of integral arborescent metallic lead, formed as before explained, with lugs *a* for connections, Fig. 2; or these electrodes may be lead plates D E, having exposed surfaces of integral arborescent metallic lead fused to said plates, Fig. 1. F represents the dilute sulphuric acid of the cell.

What I claim is—

1. An electrode for secondary batteries, formed partly or entirely of arborescent metallic lead and made integral throughout its mass, substantially as set forth.

2. An electrode for secondary batteries, composed of arborescent metallic lead and made integral throughout its mass, substantially as set forth.

This specification signed and witnessed this 3d day of June, 1882.

THOS. A. EDISON.

Witnesses:
RICHD. N. DYER,
EDWARD C. ROWLAND.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 274,293, dated March 20, 1883.

Application filed October 20, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lamps and the Manufacture Thereof, (Case No. 494,) of which the following is a specification.

The object I have in view is to increase the durability in use of the flexible carbon filaments of incandescing electric lamps by reducing as much as possible the "electrical carrying" or attraction of carbon particles from one side of the filament to the other, and from the filament to the glass of the inclosing-globe, which usually occurs in these lamps.

In incandescing electric lamps there is always a small amount of residual gas remaining in the globe after the latter is exhausted, it being of course impossible to produce a complete vacuum. I have found that when such residuum consists entirely or almost entirely of hydrochloric-acid gas the electrical carrying is greatly reduced, and consequently the life of the carbon filament is lengthened.

My invention therefore consists in providing an incandescing electric lamp with a residual atmosphere of hydrochloric-acid gas.

I prefer to accomplish my invention by first exhausting the air from the globe to as great an extent as this can be done with an ordinary air-pump, and then allowing the hydrochloric-acid gas (generated in any suitable manner) to flow into the globe to replace such air. I then re-exhaust the globe and repeat the operation of refilling and re-exhausting several times until the small residue which remains consists almost entirely of hydrochloric-acid gas. The final exhaustion should be done by means of a Sprengel pump, so that as little gas as possible will remain in the globe; or all the operations of exhausting and re-exhausting might be done by means of the Sprengel pump, means being connected with the pump for filling the globe with the hydrochloric-acid gas.

What I claim is—

An incandescing electric lamp whose residual atmosphere consists almost entirely of hydrochloric-acid gas, substantially as set forth.

This specification signed and witnessed this 14th day of October, 1882.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

RICHD. N. DYER.

(No Model.)

T. A. EDISON.

INCANDESCING ELECTRIC LAMP.

No. 274,294. Patented Mar. 20, 1883.

Fig. 1.

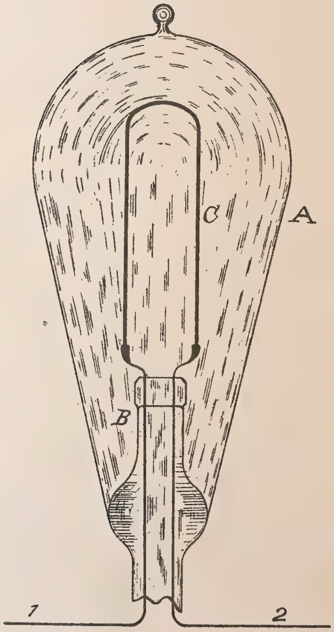
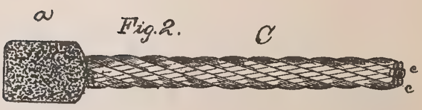


Fig. 2.



ATTEST:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd N. Dyer.
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCING ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 274,294, dated March 20, 1883.

Application filed November 23, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Electric Lamps, (Case No. 515,) of which the following is a specification.

The object I have in view is to produce flexible carbon filaments for the incandescing conductors of electric lamps which shall be of high resistance and of even resistance throughout their length, and shall have great flexibility and toughness, so that they will not be liable to be fractured by the expansion and contraction, more or less unequal, which take place from the lighting and extinguishing of the lamp.

To this end my invention consists in an incandescing conductor for an electric lamp, formed of a number of fine continuous filaments massed together, so as to be in close contact throughout the whole length, and having their ends secured, the said individual filaments being capable of independent expansion and contraction throughout the length of their bodies, between the ends, where they are brought together into solid and homogeneous masses.

In carrying out my invention I preferably take several long and very fine fibers of the same or almost the same length—such as those of ramee, flax, and similar vegetable substances—and twist them tightly together, so as to form a fibrous thread. The ends are secured preferably by a plastic carbonizable substance attached to them, such as a compound of carbon and sugar. The filament thus formed is carbonized under strain or pressure, or both, and may be bent, either before or after carbonization, into the desired form. The plastic compound upon the ends of the filament may form enlarged ends for clamping. The separate filaments are not secured together by carbonization, but remain free, except at their ends, where they become solid homogeneous masses of carbon. The ends of the twisted filament are then attached to the leading-in wires sealed in the stem or tube of a lamp, and are preferably electroplated to such wires, the fibers, before electroplating, being again twisted tightly, so as to bring them all in contact with each other through their entire length. Instead of the process described, the fibers may be carbonized straight and separately, and such carbonized fibers then twisted tightly together. The ends are then attached to the leading-in wires, preferably by electroplating, the fibers being kept tightly twisted during this process. The filament formed in either of the above ways and attached to the leading-in wires is placed in the globe of a lamp in the usual manner, and is ready for the exhausting process.

While, as stated, I prefer to use natural vegetable fibers, it is evident that a conductor of the kind described may be formed of other substances—such as cellulose, paper, parchment, fine thread treated with hydrofluoric acid, &c.—fine filaments of such substances being twisted together, as described. It will be understood that the fiber is reduced to cellulose before the separate filaments are massed together, in order to maintain the individuality of the separate filaments after carbonization. Filaments may, it is evident, be braided or intertwined instead of twisted together.

Filaments formed as described are of unusually even resistance and incandescence, as each of the fibers is continuous, extending the whole length of the filament. The filament is also exceedingly flexible and elastic, and therefore well adapted for the purpose for which it is to be used. The expansion and contraction of the solid carbon filament which take place during the use of the lamp are more or less unequal, and for this reason it is liable to be fractured; but by the use of a carbon filament made up of a number of separate filaments capable of independent expansion and contraction this danger is greatly diminished.

In the accompanying drawings, Figure 1 is a view of an incandescing electric lamp embodying my invention; and Fig. 2 represents a portion of the twisted filament, the size thereof being of course greatly exaggerated.

A is the inclosing globe, and B the inner stem, through which pass the leading-in wires 1 2, to which are attached the ends of the carbon filament C, which is formed of a number of individual fibers, *c c*, twisted together, and secured together at their ends by a plastic substance, *a*.

What I claim is—

1. A flexible carbon filament for the incan-

descing conductor of an electric lamp, formed of a number of separate continuous flexible carbon filaments massed together, substantially as set forth.

2. A flexible carbon filament for the incandescing conductor of an electric lamp, formed of a number of continuous individual carbonized natural fibers massed together, substantially as set forth.

3. A filament for forming, on carbonization, the incandescing conductor of an electric lamp, consisting of a number of separate filaments, of carbonizable material, massed together, and secured at their ends by a plastic carbonizable compound, substantially as set forth.

4. A flexible carbon filament for incandescing electric lamps, formed of a number of separate flexible carbon filaments with their ends connected in solid homogeneous masses, substantially as set forth.

5. The combination, in an incandescing electric lamp, of a chamber made entirely of glass, leading-in wires passing through and sealed in the glass of said chamber, and a flexible carbon incandescing conductor formed of a number of separate filaments massed together and secured to said leading-in wires, substantially as set forth.

This specification signed and witnessed this 13th day of November, 1882.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

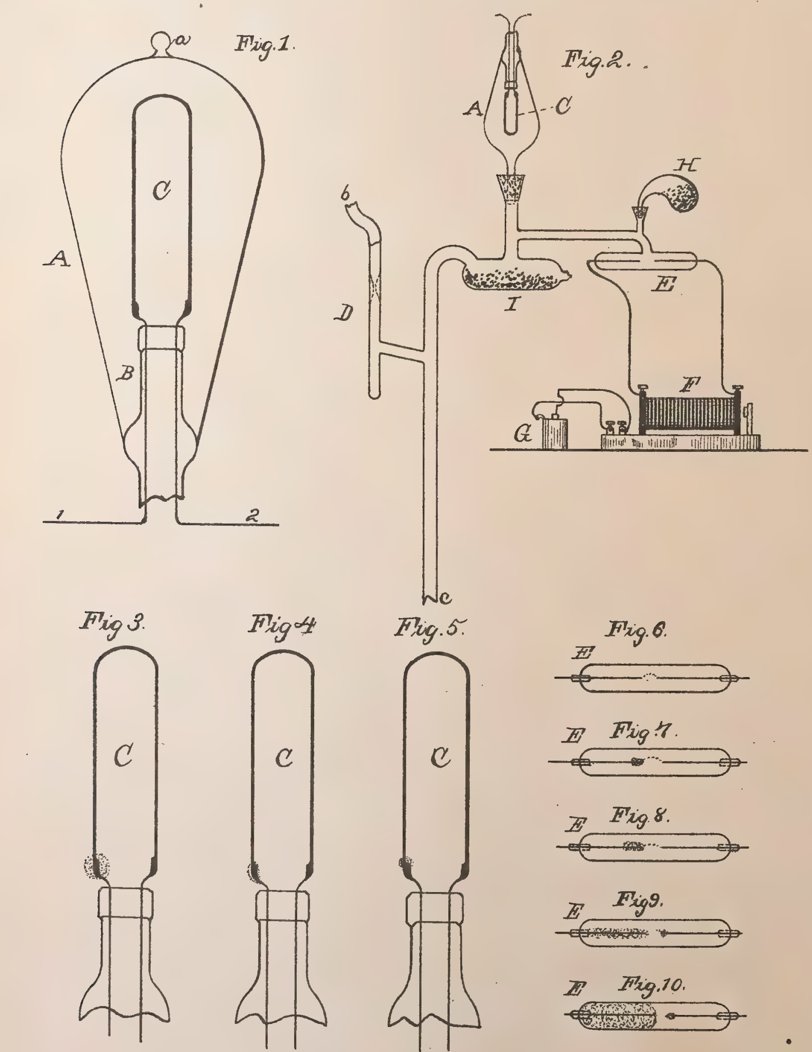
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 274,295. Patented Mar. 20, 1883.



ATTEST:

E. C. Rowlands

H. W. Seely

INVENTOR:

Thomas A. Edison

By Richd N. Dyer,
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 274,295, dated March 20, 1883.

Application filed November 23, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Electric Lamps, (Case No. 516,) of which the following is a specification.

This invention relates to incandescing electric lamps, wherein flexible filaments of carbon are inclosed in hermetically-sealed chambers made entirely of glass, with leading-in wires passing through and sealed into the glass; and the object of the invention is principally to lengthen the life of electric lamps of this character by diminishing the electrical carrying between the flexible carbon filament and the inclosing-chamber, or the metallic terminals of the filament within the lamp, and incidentally to increase the resistance of the lamp, so as to reduce the investment required for conductors.

Heretofore in electric lamps of this character it has been the general practice to produce high vacua in the glass globes previous to hermetically sealing the same, in order to preserve the carbon filaments from oxidation and to prevent the loss caused by convection of heat which takes place when the globes are filled with an inert gas.

The improvements made by me in the past upon my standard incandescing electric lamps have been principally by increasing the resistance of the flexible carbon filaments without a corresponding increase of the radiating-surface and without diminishing in the least the degree of vacuum; but I find that advance in this direction is limited by reason of the increased deposit of the carbon upon the walls of the glass chamber, obscuring the light and diminishing considerably the exterior candle-power of the lamp, and also consuming and destroying the fine filament, reducing materially the length of life of the lamp.

I have found that the amount of deposit in any given period depends generally upon the degree of incandescence per unit surface to which the carbon filament is raised, the higher the degree of incandescence the more rapid being the deposit. It also depends upon the state of the vacuum, the higher the vacuum the greater being the deposit. This deposit I have discovered is due to electrical carrying of the carbon of the filament, the phenomenon being similar to that which takes place in the well-known Geissler tubes, wherein at certain stages of the vacuum or pressure electrical carrying of the platina forming the terminals takes place, blackening the walls of the glass vacuum-chamber, notwithstanding the platina is scarcely above the temperature of the atmosphere, while at other stages of the vacuum or pressure this blackening does not take place.

I have also discovered that the economy of the carbon-filament lamp (the number of standard lamps per horse-power) increases as the pressure within the globe diminishes, up to a certain stage of the vacuum, when any higher exhaustion does not practically increase the economy. If the vacuum is diminished below this point of greatest economy to prevent electrical carrying, the economy of the lamp is diminished, since the residual air acts as a carrier of heat to the walls of the chamber, where it is rapidly dissipated; but, owing to the greatly diminished electrical carrying of the carbon from the filament when the vacuum is low, I am enabled to diminish the radiating-surface, so as to raise each unit of surface to a higher degree of incandescence than would be practicable were the vacuum higher and the electrical carrying at its maximum; and as an increase in the degree of incandescence is an advance in the direction of economy, I am enabled to regain, by the economy of higher incandescence, the energy lost by the increased convection of heat from the filament to the glass walls of the lamp, caused by the greater density of the residual gas due to a low vacuum; hence a carbon-filament lamp embodying these conditions of low vacuum and high incandescence and resistance will have a longer life than if the vacuum were higher, and its candle-power will not be diminished by the obscuration of the globe by a deposit of carbon. It will also permit of a reduction in the size of conductors for carrying the current to and from the lamps by reason of its increased resistance, and the filament itself will be more flexible and less liable to break.

In carrying out the invention the flexible carbon filament is produced by the carboniza-

tion, under strain or pressure, of any suitable organic or inorganic material, reduced or not reduced to an amorphous or semi-amorphous condition in the way now well understood. The filament before carbonization, however, may be reduced to a smaller cross-section than usual heretofore, in order to produce the reduction of radiating-surface and increase of resistance per unit of radiating-surface necessary to compensate for the loss caused by the reduced vacuum. For illustration, it may be stated that the radiating-surface can be reduced in size two-tenths; but the sizes of filaments used by me at present may be retained, the loss in economy being more than counterbalanced by the increased length of life. The flexible carbon filament is secured to the leading-in wires, which are sealed in one glass part of the lamp, and this part is fused to the glass globe of the lamp in the usual or any suitable way. The lamp is then connected with a Sprengel pump, and the globe exhausted until a high vacuum is obtained, so as to remove all oxygen from the globe. During the latter part of the operation of exhausting the lamp the flexible carbon filament may be gradually raised to an incandescence higher than that at which it is intended afterward to be used; but this heating of the filament may be omitted. After the exhaustion of the lamp-globe is completed an inert gas is allowed to pass into the globe, gradually reducing the vacuum and increasing the pressure within the globe. This is preferably done by providing the pump with a tube containing a solid substance, which, when heated, will evolve an inert gas. The heat is applied at the proper time to the exterior of the tube containing the substance. The flexible carbon filament is raised to incandescence during the time that the inert gas is being admitted into the lamp-globe and certain phenomena will be noticed during this period. As the pressure gradually increases a light-blue halo very much spread out will appear upon the positive clamp of the filament. As more gas passes in, the halo will increase in density and hug the clamp. At this pressure carbon from the filament is deposited on the clamp in considerable quantity, which is due to the increase of the electrical resistance of the vacuum and the consequent prevention of deposit upon the globe. If, now, the pressure be further increased, the blue halo leaves the metallic portions of the clamp and appears on the carbon at the juncture of the latter and the metal of the clamp. If, now, the pressure is carried beyond this point, the blue halo will disappear entirely, and the resistance of the residual gas will be so great as to nearly or quite extinguish the electrical carrying. The proper stage being reached, the lamp is sealed off from the pump while incandescent.

The particular pressure at which the lamp should be sealed off is dependent upon the nature of the residual gas. With nitrogen for the inert gas this pressure may be when a mercurial column connected with the lamp stands at a height of about twenty inches; but with hydrochloric-acid gas, on account of its greater electrical resistance, the pressure may be somewhat reduced. At twenty-nine inches with nitrogen and equivalent pressure with other gasses the electrical carrying is greatly diminished. This vacuum of twenty-nine inches or below that height for nitrogen and equivalent pressures with other gases is what I hereinafter term a "low vacuum."

Since the blue halo in the lamp disappears altogether to the eye when a certain pressure is reached, on account of the incandescence of the filament, and since the operation should be carried beyond this point, a Geissler spark-gage may be used to determine the exact point to seal off the lamp, the terminals of the Geissler spark-gage being connected to an induction-coil worked by a constant battery. A mercurial column may be used for the purpose; but the Geissler spark-gage is preferred, for the reason that the electrical carrying depends, where the vacuum is low, both upon the nature of the residual gas and the pressure, which conditions will also affect the Geissler spark-gage, in which the phenomena due to electrical carrying can be observed after their disappearance to the eye in the lamp, while the mercurial column is only affected by the pressure.

The different degrees of exhaustion at which certain phenomena will appear in the spark-gage depend upon the size and distance apart of the electrodes, as well as on the chamber of the gage and on the electro-motive force of the coil; hence it is necessary to determine, in the first instance, by the disappearance of the blue halo from the clamps of the filament, due to increased pressure, the appearance of the spark-gage at the exact moment when the lamp is to be sealed off, which is an increased pressure of several inches of a column of mercury after the disappearance of the halo from the metallic terminals of the filament. The residual gas might be allowed to flow in until the gas within the globe is at atmospheric pressure, and good results would be obtained as far as the electrical carrying is concerned; but the economy would be considerably diminished without a corresponding increase of the life of the filament; hence it is best to diminish the pressure for the sake of economy, but not to the point where the blue halo begins to appear on the metallic terminals of the filament.

Instead of exhausting to a high vacuum with a mercury-pump, and then gradually reducing the vacuum to the proper point by means of an inert gas, the lamp is first exhausted to a high vacuum, and the inert gas is then allowed to flow into the lamp until the vacuum is reduced to atmospheric pressure, when the inert gas may be pumped out until the desired pressure

is obtained; or any other way of displacing the oxygen by an inert gas and obtaining the desired pressure may be employed.

The making of the inclosing-chamber entirely of glass, through which the leading-in wires are passed and in which they are sealed, and the hermetical closing of such glass inclosing-chamber, assure the retention of the same conditions of pressure that it is found desirable to give the lamp when manufactured, which is a feature of essential importance in lamps with a low vacuum, as well as with lamps having a high vacuum. Since electrical carrying takes place also with incandescing conductors made of other material than carbon, I do not wish to limit myself to carbon, but intend to include all flexible filamentary incandescing conductors having, like carbon, a high specific resistance.

In the accompanying drawings, Figure 1 is a view of the lamp; Fig. 2, an elevation showing the principal parts of the pump and the devices connected therewith. Figs. 3, 4, and 5 illustrate the phenomena that appear at the positive clamp of the filament, and Figs. 6, 7, 8, 9, and 10 illustrate the phenomena that appear in the Geissler spark-gage.

A is the glass lamp-globe, fused to the inside glass part, B, through which pass the leading-in wires 1 2, such wires being sealed into the upper end of B by the fusion of the glass around and upon them.

C is the flexible carbon filament, secured to the leading-in wires in any suitable way. The globe A is provided with an inert gas at a low vacuum or atmospheric pressure, as before described, and is sealed at *a*.

D is the Sprengel pump, the mercury entering at *b* and passing out at *c*.

E is a Geissler spark-gage, connected with the exhaust-tube of the pump. Its terminals are connected with an induction-coil, F, worked by a constant battery, G.

H is a chamber or tube, also connected with the exhaust-tube of the pump. The tube H contains the solid material for producing the inert gas when the tube is heated. This material may be, for illustration, solid cyanide of mercury, which evolves cyanogen when heated. Other inert gases may, however, be used, being evolved from the decomposition of different salts by heat. The exhaust-tube may be connected with a reservoir of pure inert gas which can be allowed to pass, as desired, into the vacuum by means of a stop-cock; but the method first described is preferred, since it is quite impracticable to manipulate the gas or make it free from oxygen. This difficulty is not met with when the gas is evolved from a solid in a tube by the application of heat to the exterior of the tube, and the heat can be so applied as to set free the exact quantity of gas desired, the quantity being regulated with a nicety and exactness which cannot be obtained with a stop-cock.

I is a chamber or tube containing a drying agent.

Figs. 3, 4. and 5 represent the appearance of the blue halo on the positive clamp at three stages; Fig. 3, when it first appears, which corresponds with nitrogen for the inert gas, to a pressure shown in the mercury column of thirty and three-sixteenths inches; Fig. 4, when it becomes dense and hugs the clamp, which occurs at a pressure of twenty-nine and nine-sixteenths inches; and Fig. 5, when it is about to disappear, which occurs at a pressure of twenty-eight and fifteen-sixteenths inches. Figs. 6, 7, 8, 9, and 10 represent the phenomena of the spark-gage. Fig. 6 shows the spark between the terminals at the atmospheric pressure. Fig. 7 shows a halo on the end of the positive pole, which occurs at twenty inches. Figs. 8 and 9 show it extending along the wire, which occurs at about twenty-nine and five-eighths inches; and Fig. 10 shows the halo spread out so as to touch the walls of the tube, which occurs at thirty and one-fourth inches of the mercury column.

What I claim is—

1. An incandescing electric lamp having, in combination, the following three elements, viz: a flexible carbon filament, an inclosing-chamber, and an inert gas having the definite high pressure described, whereby electrical carrying of the carbon to the walls of the inclosing-chamber or the metallic terminals of the filament within the lamp is prevented, substantially as set forth.

2. An incandescing electric lamp having, in combination, a flexible carbon filament, a hermetically-sealed inclosing-chamber made entirely of glass, leading-in wires passing through and sealed into the glass, and an inert gas having the definite high pressure described, for the purpose set forth.

3. The method of completing incandescing electric lamps having flexible carbon filaments and inclosing-chambers entirely of glass, consisting in exhausting the inclosing-chambers until a high vacuum is obtained for removing the oxygen, then filling the chambers with an inert gas at a pressure sufficiently high to cause the disappearance of the blue halo from the positive clamp of the filament, and then hermetically sealing the chambers by a fusion of the glass, substantially as set forth.

4. The method of completing incandescing electric lamps having flexible carbon filaments and inclosing-chambers entirely of glass, consisting in exhausting the inclosing-chambers until a high vacuum is obtained for removing the oxygen, then raising the filaments to incandescence, then filling the chambers with an inert gas at a pressure sufficiently high to cause the disappearance of the blue halo from the positive clamp of the filament, and then hermetically sealing the chambers by a fusion of the glass while the filaments are incandescent, substantially as set forth.

5. The method of completing incandescing electric lamps, consisting in exhausting the lamp, and at the same time exhausting a chamber connected with said lamp, and containing a material evolving an inert gas when heated, then heating such chamber externally to evolve the gas, then filling the lamp with the inert gas at a pressure sufficiently high to cause the disappearance of the blue halo from the positive clamp of the filament, and then sealing off said lamp from connection with said chamber and the exhausting apparatus, substantially as set forth.

This specification signed and witnessed this 14th day of November, 1882.

THOS. A. EDISON.

Witnesses:
WM. H. MEADOWCROFT,
EDWARD H. PYATT.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MANUFACTURE OF INCANDESCENTS.

SPECIFICATION forming part of Letters Patent No. 274,296, dated March 20, 1883.

Application filed August 14, 1882. (No specimens.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescing Conductors for Electric Lamps, (Case No. 456;) and I do hereby declare that the following is a full and exact description of the same.

The object I have in view is to provide a cheap and efficient material and method for producing flexible carbon filaments for use as the incandescing conductors of electric lamps. This I accomplish by the use of gluten, or a mixture thereof with starch or other material. The gluten is obtained by removing the starch from the flour of cereals; but a part or all of the starch may be allowed to remain mixed with the gluten. A dough or paste is formed of the gluten or gluten and starch with the minimum amount of water, and the dough is then pressed out on polished surfaces into sheets of uniform thickness. Filaments of the desired shape with enlarged ends are punched from the dough and are dried, after which they are carbonized by heat under strain and pressure; or the dough is forced by pressure from a chamber through an orifice in the shape of a long filament, and is cut into proper lengths. Extra pieces of dough are put on the ends of the cut filaments to form the enlarged clamping ends, when the filaments are bent into proper shape and dried, after which they are carbonized by heat under strain and pressure. The filaments made in either way described may be dried under strain or strain and pressure to preserve their shape.

What I claim is—

A flexible carbon filament for incandescing electric lamps, formed of carbonized gluten, or a mixture thereof with other materials, substantially as set forth.

This specification signed and witnessed this 5th day of July, 1882.

THOMAS A. EDISON.

Witnesses:

C. P. MOTT,

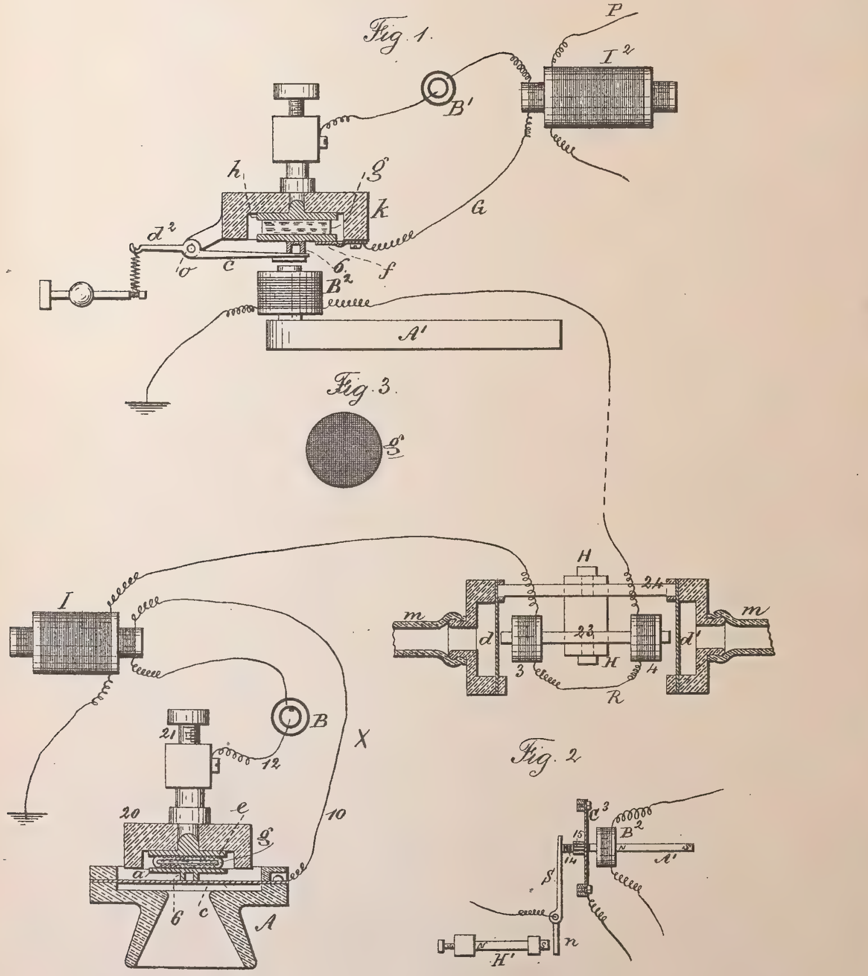
RICHD. N. DYER.

(No Model.)

T. A. EDISON.

TRANSMITTING TELEPHONE.

No. 274,576. Patented Mar. 27, 1883.



Witnesses
J. Staib
Chas. H. Smith

Inventor:
Thomas A. Edison
per Lemuel W. Serrell atty

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

TRANSMITTING-TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 274,576, dated March 27, 1883.

Application filed October 6, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Transmitting-Telephones, (Case No. 159B,) of which the following is a specification.

This application is a division of my application filed November 18, 1878, No. 159, and said division is made for the purpose of separating from the said original application the different features of invention into three additional applications. The present I term "Case No. 159B."

In my application No. 130, heretofore filed, the circuit passes through plumbago or similar material, and the diaphragm that is acted upon by the sound-waves serves to vary the electric tension by the extent of surface contact.

In my Case No. 151, patented April 30, 1878, No. 203,016, I have shown an induction-coil with primary and secondary circuits and receiving and transmitting telephones. A carbon button in a circuit and acted upon by the diaphragm is shown in my said Case 151 and also in Case 141. These are not therefore claimed herein.

In my present improvement I make use of a surface or surfaces having numerous points produced by scores or fine lines across the surface, preferably about at right angles to each other, and this surface or surfaces are in the electric circuit and combined with the diaphragm, so that the movement given to the diaphragm by the sound-waves will produce greater or less intimacy of contact at the scored surface and a consequent rise and fall of electric tension. I also combine with a button of carbon or equivalent material in one circuit an electro-magnet in another circuit, the armature of which varies the pressure upon such carbon or other finely-divided material, and by this means repeats the telephonic pulsations. I also construct the telephonic receiver in a peculiar manner to prevent injury by undue currents, such as from lightning, and so that the diaphragms and cores will be polarized by induction, and the line-current will act in two helices to vary the magnetism.

In the drawings, the diagram Figure 1 represents the transmitting, receiving, and repeating instruments, the instruments at X being at one station and the instruments at G being at the repeating-station. Fig. 2 is a detached view of a modification of the repeating-instrument, and Fig. 3 is a face view of the tension-regulator formed by a surface scored with numerous lines.

The telephonic transmitter A is made with a case containing the diaphragm or plate *c*, against which the sound acts to vibrate the same.

The plate *e* is in the bottom of a vulcanite cup or holder, 20, and can be adjusted nearer to or farther from the diaphragm *c* by the screw 21.

The tension-regulating device *g* is between the plate *e* and the second plate, *a*, the wires 10 and 12 of the circuit to the battery B connecting, so that the circuit passes through these plates and the intervening tension-regulator. The tension-regulating device is composed of two contiguous surfaces, one or both of which are scored with numerous fine lines, so as to produce a great number of contact-points. By adjusting the screw 21 the initial pressure can be regulated, and the vibrations of the diaphragm due to the action of sounds will vary the pressure and the extent of surface contact, so as to produce rise and fall of tension in the circuit by bringing more or less of the points on the surface or surfaces into contact.

In Fig. 3 I have shown the surface scored as aforesaid, and it is to be understood that the scoring is to be of the requisite fineness, preferably several thousand to the inch.

In the instrument A, Fig. 1, the tension-regulator is composed of a strip of platina scored by lines of ruling at right angles, and folded, with a piece of felt, rubber, or similar material within the fold, and the scored surfaces in contact with the plates *a* and *e*, respectively. Several layers of foil ruled as aforesaid may be placed together, if desired, to obtain great resistance and variation in the electric tension of the circuit. The foil ruled as aforesaid is believed to operate in the circuit in a similar manner to a carbon button. Between the diaphragm *c* and plate *a* there is a short section of a tube, 6, to form a central bearing.

The inductorium I has its primary included

in the circuit to the battery B and tension-regulator and its secondary to the line and ground. The receiving-telephone R is placed in the line-circuit passing through the secondary of the inductorium. At the receiving-instrument R there is a permanent magnet, H, and upon one pole there is a bar, 23, forming at its ends the cores for the helices 3 and 4, that are in the line-circuit; and upon the other pole of the magnet H there is a bar, 24, that is connected at its ends to the diaphragms *d d*. These diaphragms hence are polarized by induction, and are of one polarity—say south—while the cores 3 and 4 are polarized north by induction. Flexible tubes *m*, with ear-pieces, are connected to the chambers or cases holding the diaphragms *d d'*, so that the sound is conveyed to the ears. This apparatus is not liable to become demagnetized, because any current which passes through the helices 3 and 4 acts to increase the induced magnetism at one end of the bar 23 in proportion as it tends to decrease the induced magnetism in the other end. Thus there will be no tendency to injure the permanent magnet H; but the telephonic current will cause the diaphragms to respond by the change of magnetism in the cores adjacent to the diaphragms.

The repeating-instrument at the station G contains an electro-magnet, B^2, the helix of which is in the main-line circuit. Its core is adjacent to an iron plate or armature, and the variation of the magnetism resulting from the action of the current in the main line increases and decreases the pressure upon a button of carbon, *g*, or similar material forming the tension-regulator in a second electric circuit. I have shown the local circuit from the battery B' as passing to the plate *f* at one side of the circuit-regulator *g* and to the adjusting device of the plate *h* at the other side of the carbon or similar material; and in this local circuit is the primary of the inductorium I^2, the secondary of which is in the line P, to the distant receiving-instrument. I prefer to connect the core of the electro-magnet B^2 to one pole of the permanent magnet A', so that it may be polarized by induction, and hence the line-current will increase or decrease the magnetism of the core of B^2. The armature-plate of the magnet B^2 is shown upon a lever, *c*, having a fulcrum at *o*, and the spring at d^2, which should be adjustable, serves to apply an initial pressure to the tension-regulator *g*, and I prefer to use a short cylinder, 6, between the armature-plate and the disk *f*, to insure a central bearing on the tension-regulator. When an electric wave from the distant station varies the power of the magnet B^2 the pressure upon the tension-regulator *g* is decreased or increased, and the primary current from B' acts in the inductorium to translate or reproduce on the second line, P, currents corresponding or proportionate to those sent from the instrument A. The receiving-telephone, being in the main line, responds to the electric waves transmitted by the inductorium as the resistance in the primary of the inductorium is varied by the transmitting-instrument.

The instrument shown in Fig. 2 is a very delicate translator, acting similarly to that in Fig. 1. The electro-magnet B^2 has a helix in the line-circuit, as before, and A' is its polarized core. C^3 is a diaphragm, and S is a lever, the short end *n* of which is attached by an adjustable magnet, H'. Between the lever S and diaphragm C^3 there are the pieces 14 and 15, of carbon or other finely-divided material, that act as a tension-regulator for the translating or repeating circuit that passes through the lever S and diaphragm C^3; hence the rise and fall of electric tension in the repeating-circuit will result from the vibrations of the diaphragm, producing more or less pressure and intimacy of contact in the tension-regulator at 14 15, the initial pressure being determined by the proximity of the magnet H' to the lever S.

It will be observed that in my telephone-instruments I provide an electric tension-regulator having an extended surface, in contradistinction to a point or small bearing such as shown in my application No. 141, and instead of the electric tension-regulator coming directly into contact with the diaphragm, as in my application No. 130, I combine with the electric tension-regulating device an intermediate bearing having a small contact with the diaphragm and the required extent of surface against the tension-regulator. This bearing is non-elastic to transfer more positively to the tension-regulator the tremulous movements of the diaphragm, as distinguished from the yielding material, such as cork or rubber, as shown in my Patent No. 203,016. If the current passes through this non-elastic bearing-piece, as at A, the same is to be of metal or other good conductor.

Certain of the devices shown herein are not claimed, as they form the subject of other applications.

I claim as my invention—

1. In a telephonic transmitter, the combination, with the diaphragm, of one or more metallic plates the surface or surfaces of which are scored with numerous fine lines to form a tension-regulator in an electric circuit, substantially as set forth.

2. In a telephonic transmitter, the combination, with the diaphragm and the electric circuit, of two contiguous surfaces, one of which is scored with numerous fine lines to form a tension-regulator, substantially as set forth.

3. The combination, with the diaphragm in a telephonic transmitter, of a tension-regulator, a metallic surface at each side of the same, and a central bearing between the diaphragm and one of the metallic surfaces that inclose the tension-regulator, substantially as set forth.

4. In a speaking-telephone, the combination, with the diaphragm and the tension-regulator,

of an intermediate bearing of non-elastic material having a small surface in contact with the diaphragm, substantially as set forth.

5. In a speaking-telephone, the combination, with the diaphragm, of two plates or rigid surfaces, an elastic circuit-regulator between the said rigid surfaces, and a non-elastic bearing of small area between one of the rigid plates and the diaphragm, substantially as set forth.

6. In a speaking-telephone, the combination, with the diaphragm and tension-regulator, of two rigid plates or surfaces, one at each side of the tension-regulator, and an adjusting device to regulate the initial pressure upon the tension-regulator and against the diaphragm, substantially as set forth.

7. The combination, in a telephone-instrument, of a diaphragm the edges of which are clamped in a case and a mouth-piece, a tension-regulator, a cup or recess for the same, a non-elastic plate between the tension-regulator and the diaphragm, and a non-elastic bearing against said diaphragm, substantially as set forth.

Signed by me this 30th day of March, A. D. 1882.

THOMAS A. EDISON.

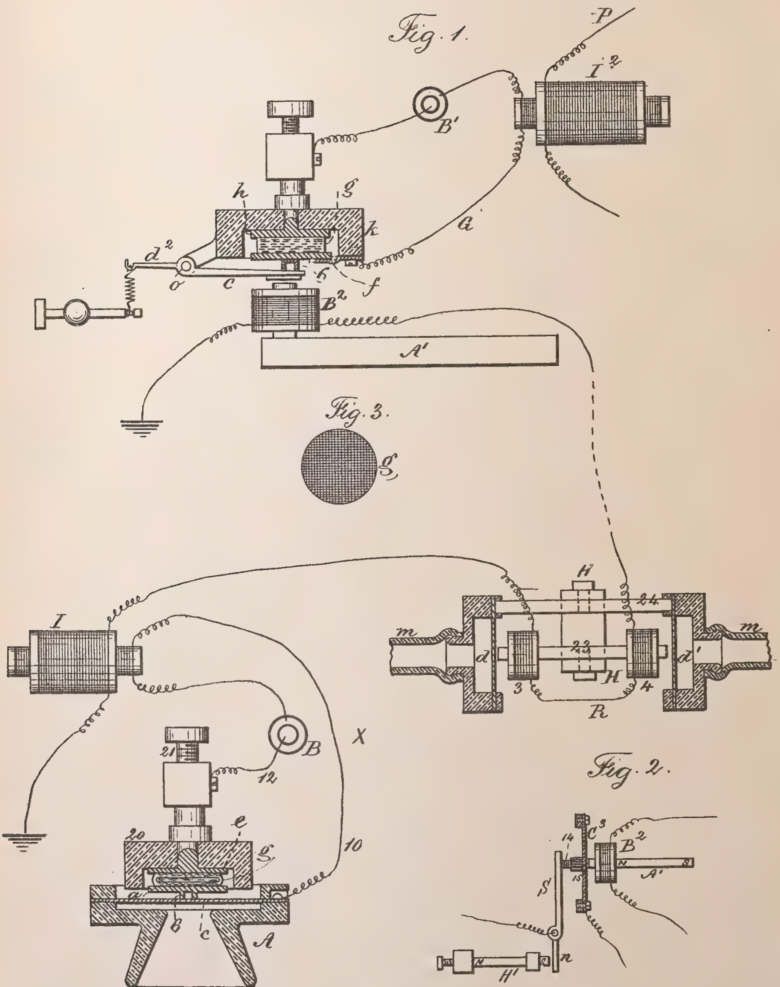
Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

(No Model.)

T. A. EDISON.

TELEPHONE.

No. 274,577. Patented Mar. 27, 1883.



Witnesses:

J. Staib

Chas H. Smith

Inventor

Thomas A. Edison

per Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 274,577, dated March 27, 1883.

Application filed October 6, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Telephones, (Case No. 159^{C},) of which the following is a specification.

This application is a division of my application filed November 18, 1878, No. 159, and said division is made for the purpose of separating from the said original application the different features of invention into three additional applications. The present I term "Case No. 159^{C}."

In my application No. 130, heretofore filed, the circuit passes through plumbago or similar material, and the diaphragm that is acted upon by the sound-waves serves to vary the electric tension by the extent of surface contact.

In my Case No. 151, patented April 30, 1878, No. 203,016, I have shown an induction-coil with primary and secondary circuits and receiving and transmitting telephones. A carbon button in a circuit and acted upon by the diaphragm is shown in my said Case 151 and also in Case 141. These are not therefore claimed herein.

In my present improvement I make use of a surface or surfaces having numerous points produced by scores or fine lines across the surface, preferably about at right angles to each other, and this surface or surfaces are in the electric circuit and combined with the diaphragm, so that the movement given to the diaphragm by the sound-waves will produce greater or less intimacy of contact at the scored surface and a consequent rise and fall of electric tension. I also combine with a button of carbon or equivalent material in one circuit an electro-magnet in another circuit, the armature of which varies the pressure upon such carbon or other finely-divided material, and by this means repeats the telephonic pulsations. I also construct the telephonic receiver in a peculiar manner to prevent injury by undue currents, such as from lightning, and so that the diaphragms and cores will be polarized by induction, and the line-current will act in two helices to vary the magnetism.

In the drawings, the diagram Figure 1 represents the transmitting, receiving, and repeating instruments, the instruments at X being at one station and the instruments at G being at the repeating-station. Fig. 2 is a detached view of a modification of the repeating-instrument, and Fig. 3 is a face view of the tension-regulator formed by a surface scored with numerous lines.

The telephonic transmitter A is made with a case containing the diaphragm or plate *c*, against which the sound acts to vibrate the same.

The plate *e* is in the bottom of a vulcanite cup or holder, 20, and can be adjusted nearer to or farther from the diaphragm *c* by the screw 21.

The tension-regulating device *g* is between the plate *e* and the second plate, *a*, the wires 10 and 12 of the circuit to the battery B connecting, so that the circuit passes through these plates and the intervening tension-regulator.

The tension-regulating device is composed of two contiguous surfaces, one or both of which are scored with numerous fine lines, so as to produce a great number of contact-points. By adjusting the screw 21 the initial pressure can be regulated, and the vibrations of the diaphragm due to the action of sounds will vary the pressure and the extent of surface contact, so as to produce rise and fall of tension in the circuit by bringing more or less of the points on the surface or surfaces into contact.

In Fig. 3 I have shown the surface scored as aforesaid, and it is to be understood that the scoring is to be of the requisite fineness, preferably several thousand to the inch.

In the instrument A, Fig. 1, the tension-regulator is composed of a strip of platina scored by lines of ruling at right angles, and folded, with a piece of felt, rubber, or similar material within the fold, and the scored surfaces in contact with the plates *a* and *e*, respectively. Several layers of foil ruled as aforesaid may be placed together, if desired, to obtain great resistance and variation in the electric tension of the circuit. The foil ruled as aforesaid is believed to operate in the circuit in a similar manner to a carbon button. Between the diaphragm *c* and plate *a* there is

a short section of a tube, 6, to form a central bearing.

The inductorium I has its primary included in the circuit to the battery B and tension-regulator and its secondary to the line and ground. The receiving-telephone R is placed in the line-circuit passing through the secondary of the inductorium. At the receiving-instrument R there is a permanent magnet, H, and upon one pole there is a bar, 23, forming at its ends the cores for the helices 3 and 4, that are in the line-circuit, and upon the other pole of the magnet H there is a bar, 24, that is connected at its ends to the diaphragms *d d*. These diaphragms hence are polarized by induction, and are of one polarity—say south—while the cores of 3 and 4 are polarized north by induction. Flexible tubes *m*, with ear-pieces, are connected to the chambers or cases holding the diaphragms *d d'*, so that the sound is conveyed to the ears. This apparatus is not liable to become demagnetized, because any current which passes through the helices 3 and 4 acts to increase the induced magnetism at one end of the bar 23 in proportion as it tends to decrease the induced magnetism in the other end. Thus there will be no tendency to injure the permanent magnet H; but the telephonic current will cause the diaphragms to respond by the change of magnetism in the cores adjacent to the diaphragms.

The repeating-instrument at the station G contains an electro-magnet, D^2, the helix of which is in the main-line circuit. Its core is adjacent to an iron plate or armature, and the variation of the magnetism resulting from the action of the current in the main line increases and decreases the pressure upon a button of carbon, *g*, or similar material, forming the tension-regulator in a second electric circuit. I have shown the local circuit from the battery B' as passing to the plate *f* at one side of the circuit-regulator *g*, and to the adjusting device of the plate *h* at the other side of the carbon or similar material, and in this local circuit is the primary of the inductorium I^2, the secondary of which is in the line P to the distant receiving-instrument. I prefer to connect the core of the electro-magnet B^2 to one pole of the permanent magnet A', so that it may be polarized by induction, and hence the line-current will increase or decrease the magnetism of the core of B^2. The armature-plate of the magnet B^2 is shown upon a lever, *c*, having a fulcrum at *o*, and the spring at d^2, which should be adjustable, serves to apply an initial pressure to the tension-regulator *g*, and I prefer to use a short cylinder, 6, between the armature-plate and the disk *f*, to insure a central bearing on the tension-regulator. When an electric wave from the distant station varies the power of the magnet B^2 the pressure upon the tension-regulator *g* is decreased or increased, and the primary current from B' acts in the inductorium to translate or reproduce on the second line, P, currents corresponding or proportionate to those sent from the instrument A.

The instrument shown in Fig. 2 is a very delicate translator, acting similarly to that in Fig. 1. The electro-magnet B^2 has a helix in the line-circuit, as before, and A' is its polarized core. C^3 is a diaphragm, and S is a lever, the short end, *n*, of which is attracted by an adjustable magnet, H'. Between the lever S and diaphragm C^3 there are the pieces 14 and 15, of carbon or other finely-divided material, that act as a tension-regulator for the translating or repeating circuit that passes through the lever S and diaphragm C^3; hence the rise and fall of electric tension in the repeating-circuit will result from the vibrations of the diaphragm, producing more or less pressure and intimacy of contact in the tension-regulator at 14 15, the initial pressure being determined by the proximity of the magnet H' to the lever S.

It will be observed that the vibrations of the diaphragm act upon the carbons 14 and 15 to vary the electric tension in the circuit passing through them, and that the magnet H' and lever S form the resistance behind the carbons.

It will be observed that in my telephone instruments I provide an electric tension-regulator having an extended surface, in contradistinction to a point or small bearing such as shown in my application No. 141, and instead of the electric-tension regulator coming directly into contact with the diaphragm, as in my application No. 130, I combine with the electric tension-regulating device an intermediate bearing having a small contact with the diaphragm and the required extent of surface against the tension-regulator. This bearing is non-elastic to transfer more positively to the tension-regulator the tremulous movements of the diaphragm, as distinguished from the yielding material—such as cork or rubber—as shown in my Patent No. 203,016. If the current passes through this non-elastic bearing piece, as at A, the same is to be of metal or other good conductor.

Certain of the devices shown herein are not claimed, as they form the subject of other applications.

I claim as my invention—

1. In a telephone, the combination, with the diaphragm and the tension-regulating device, of a magnet to secure the desired initial pressure upon the tension-regulator, substantially as set forth.

2. The combination, in a telephone, of two electrodes, one of which is connected with the diaphragm, a lever carrying the other electrode, and a magnet acting to secure the desired initial pressure of the electrodes, substantially as set forth.

3. The combination, with a diaphragm, of an electro-magnet in one circuit acting to vibrate such diaphragm, a tension-regulator in an-

other circuit acted upon by such diaphragm, and a yielding-pressure device to apply an initial pressure to the tension-regulator, substantially as set forth.

4. The combination, in a telephone, of a diaphragm, a lever-arm, and two electrodes of carbon or similar material, one of which is connected with the diaphragm and the other with the said arm, substantially as set forth.

Signed by me this 30th day of March, A. D. 1882.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 275,612, dated April 10, 1883.

Application filed October 20, 1882. (No specimens.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescing Electric Lamps, (Case No. 491,) of which the following is a specification.

In the manufacture of flexible carbon filaments for use as the incandescing conductors of electric lamps, it is usual to first carbonize the organic fibers from which such filaments are formed, and afterward place them within the lamp-globes, which are then exhausted and sealed off. In this process more or less time must elapse before a carbon filament is placed in its globe. During this time, as carbon is very susceptible to moisture, the filament may absorb a certain amount of moisture from the atmosphere, which may injure it to some extent.

The object I have in view is to remedy this difficulty, and I accomplish this by dipping the filament, after carbonization, in a strong solution of carbonizable material until it becomes coated and its pores become impregnated with such material. The filament is then dried and attached to the leading-in wires, when it is ready to be incorporated into the lamp. After the filament is placed in the lamp such lamp is exhausted of air, preferably by means of a Sprengel vacuum-pump, and during the latter portion of this process of exhaustion, after a nearly complete vacuum is attained, the filament is heated to incandescence by an electric current. This results in the carbonization of the deposited carbonizable material, and a homogeneous flexible carbon filament of high resistence is produced. After the lamp is exhausted to as nearly complete a vacuum as possible it is hermetically sealed by the fusion of the glass. During the time which intervenes between the preparation of a filament and its incorporation into the lamp its surface is covered with the carbonizable substance, and it therefore does not absorb the atmospheric moisture, as it otherwise might. By carbonizing this substance by the heat of an electric current in a vacuum where a minimum of oxygen is present such carbonization is more completely accomplished, the volatile portions being more readily driven off. I prefer to dip the carbonized filaments in a solution of sugar, though many other carbonizable materials may be employed, such as camphor, anthracine, shellac, or substances analogous to these. The substance used is dissolved in its proper solvent and the filament dipped in this solution.

What I claim is—

1. The process of preparing the incandescing conductors of electric lamps, consisting in first carbonizing filaments of the desired material, then soaking the same in a solution of carbonizable material, and then carbonizing the whole in a vacuum, substantially as set forth.

2. The process of manufacturing incandescing electric lamps, consisting in carbonizing a filament of proper material, soaking said filament in a solution of carbonizable material, placing said filament in the lamp-globe, exhausting the air from said globe, the filament being heated to incandescence during the latter portion of the exhausting process, and finally hermetically sealing the globe, substantially as set forth.

This specification signed and witnessed this 14th day of October, 1882.

THOS. A. EDISON.

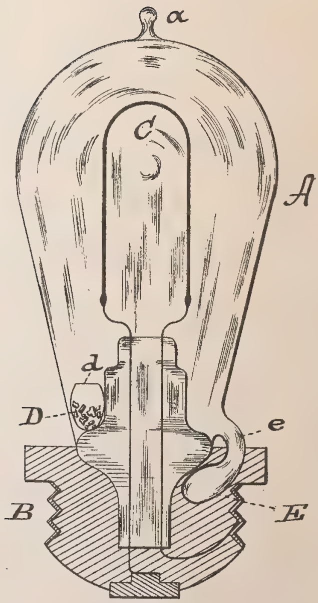
Witnesses:
H. W. SEELY,
RICHD. N. DYER.

(No Model.)

T. A. EDISON.

INCANDESCING ELECTRIC LAMP.

No. 275,613. Patented Apr. 10, 1883.



WITNESSES:

Thomas E. Birch.

D. D. Mott

INVENTOR:

T. A. Edison

BY Richd. N. Dyer.

ATTORNEY

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCING ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 275,613, dated April 10, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Electric Lamps, (Case 397;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In my Patent No. 248,416 is described an incandescing electric lamp having crystals of naphthaline or other similar carbon compound placed in the globe for continuously supplying and repairing the waste of the more defective spots of the carbon filament. When the carbon is deposited, however, the hydrogen or other gas is set free and tends to impair the stability of the vacuum.

The object, therefore, that I have in view is to provide means for repairing continuously the waste of the carbon filament during the life of the lamp, and at the same time to maintain the stability of the vacuum. This I accomplish by providing the same lamp with tetrachloride or other chloride of carbon, or preferably with a mixture thereof, with naphthaline crystals or other similar compound of carbon volatilizable at low heat, and with a gas-absorbing heat. The mixture is decomposed into carbon and hydrochloric-acid gas, the carbon being deposited in the form of hard carbon on the defective spots of the carbon filament, and the hydrochloric-acid gas set free being absorbed by the gas-absorbing material, which is preferably charcoal, as such substance is capable of readily absorbing very many times its own bulk of the gas named without materially detracting from its capacity for the absorption of other gases, and will therefore take up, in addition to the hydrochloric-acid gas, all the hydrogen or other gas which may exude from the carbon or the clamps when they are heated. The crystals of chloride of carbon, or a mixture thereof with naphthaline, are preferably inclosed in a small spherical vessel of glass, perforated to permit the escape of the vapors therefrom, and secured by fusion or by a cement to the inside of the lamp, or they may be contained by a tube projecting from the globe. The gas-absorbing material is, as stated, preferably of charcoal, (a dense cocoa-nut charcoal being best for the purpose,) and is placed in a tube closed at its outer end and connected at its inner end with the lower part of the lamp-globe. This tube is heated to a high temperature when the lamp is exhausted, so as to drive the air out of the charcoal, and after the lamp is sealed the tube is bent down and inclosed partly or wholly by the molded base or collar of the lamp.

It is evident that this process of decomposing the vapor of a material containing carbon by the heat of the incandescing carbon filament of an electric lamp in the presence of a gas-absorbing material could be used for building up and equalizing the resistance of such filaments.

The foregoing will be better understood from the drawing, in which the lamp is represented in vertical section.

A is the globe of the lamp, exhausted and sealed off at *a*.

B is the molded base of the same.

C is the carbon filament within A, connected by leading-in wires passing through and sealed into the glass, with terminals on the base B.

D is the chloride of carbon, or mixture of that substance with naphthaline, inclosed in glass vessel *d*, secured by fusion to some point on the inside of the lamp.

E is the charcoal, inclosed in tube *e*, buried in the base B.

In my Patent No. 248,428 I have described a method of removing the gases occluded in the incandescing conductor, consisting in heating the conductor in a high vacuum in the presence of a material which will absorb the gases eliminated from such conductor, and I do not claim such invention herein.

What I claim is—

1. The within-described process of repairing the waste of or building up the incandescing carbon filament of an electric lamp, or equalizing the resistance of such filament, consisting in decomposing the vapor of a material containing carbon by the heat of the incandescing carbon filament in the presence of a material which will absorb the gas set free.

2. An incandescing electric lamp provided with a compound of carbon volatilizable at low

heat and a gas-absorbing material, substantially as and for the purpose set forth.

3. The within-described process of repairing the waste of or building up the incandescing carbon filament of an electric lamp, consisting in decomposing the vapor of a mixture of chloride of carbon and a hydrocarbon by the heat of the incandescing carbon filament in the presence of a substance which will readily absorb the gas set free.

4. An incandescing electric lamp provided with a chloride of carbon vapor for depositing carbon upon the carbon filament by decomposing such vapor by the heat of the filament, substantially as set forth.

This specification signed and witnessed this 10th day of February, 1882.

THOMAS A. EDISON.

Witnesses:
RICHD. N. DYER,
WM. H. MEADOWCROFT.

(No Model.)

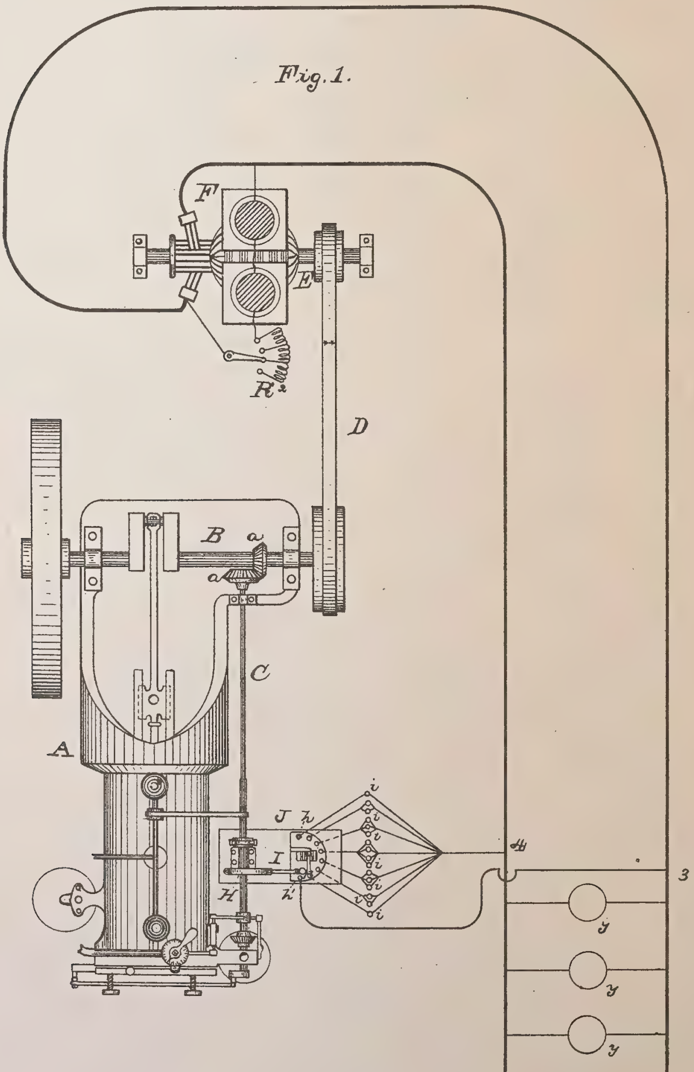
4 Sheets—Sheet 1.

T. A. EDISON.

MEANS FOR OPERATING AND REGULATING ELECTRICAL GENERATORS.

No. 276,232. Patented Apr. 24, 1883.

Fig. 1.



ATTEST:

Edward C. Rowland

Henry W. Seely

INVENTOR

Thomas A. Edison,

By Richd. N. Dyer, Atty.

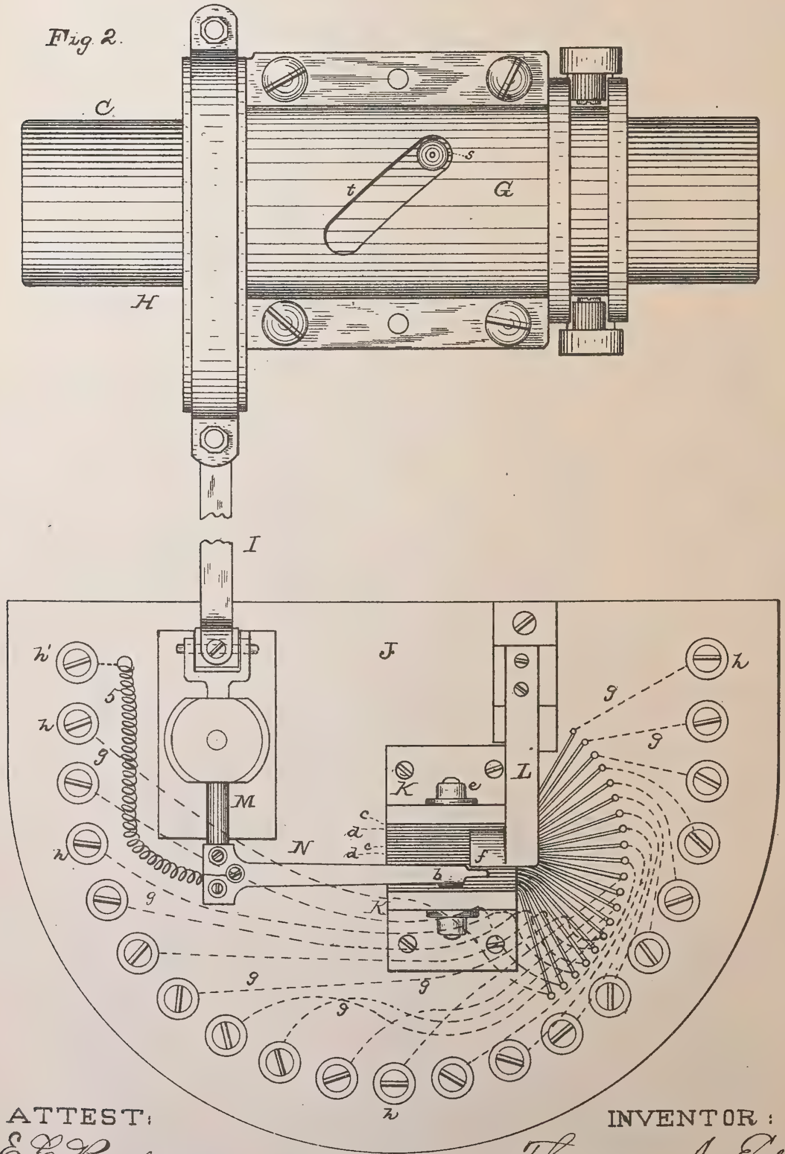
(No Model.) 4 Sheets—Sheet 2.

T. A. EDISON.

MEANS FOR OPERATING AND REGULATING ELECTRICAL GENERATORS.

No. 276,232. Patented Apr. 24, 1883.

Fig. 2.



ATTEST:

E. C. Rowland

Henry W. Seely

INVENTOR:

Thomas A. Edison

By Richd. N. Dyer

Atty.

(No Model.) 4 Sheets—Sheet 3.

T. A. EDISON.

MEANS FOR OPERATING AND REGULATING ELECTRICAL GENERATORS.

No. 276,232. Patented Apr. 24, 1883.

Fig. 3.

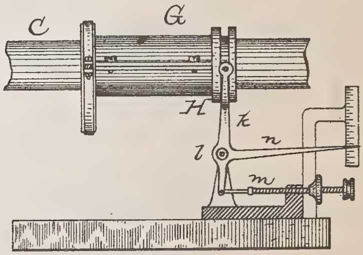


Fig. 4.

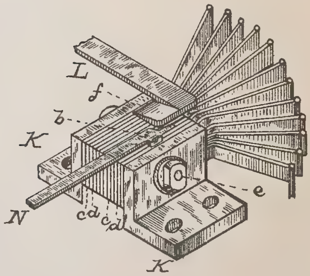
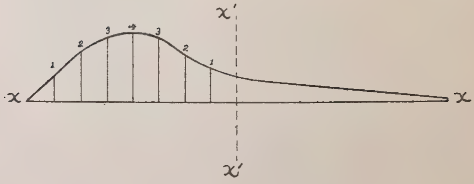


Fig. 5.



ATTEST:
E. C. Rowland,
Henry W. Seely

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer,
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 4 Sheets—Sheet 4.

T. A. EDISON.

MEANS FOR OPERATING AND REGULATING ELECTRICAL GENERATORS.

No. 276,232. Patented Apr. 24, 1883.

Fig. 6.

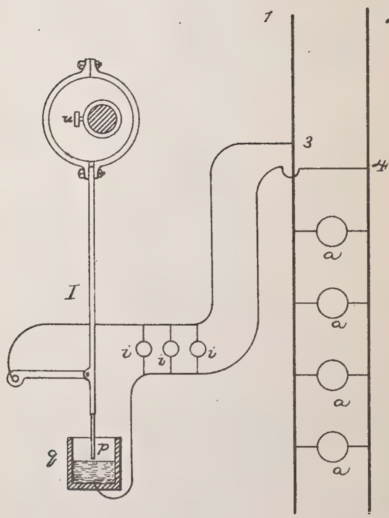


Fig 7.

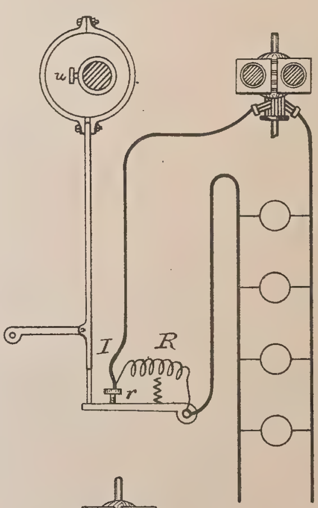
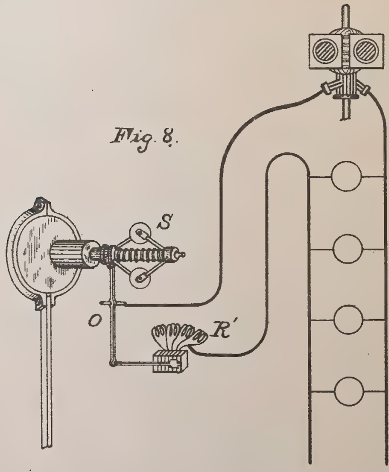


Fig. 8.



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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MEANS FOR OPERATING AND REGULATING ELECTRICAL GENERATORS.

SPECIFICATION forming part of Letters Patent No. 276,232, dated April 24, 1883.

Application filed January 8, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Means for Operating Electrical Generators, (Case No. 532,) of which the following is a specification.

All attempts which have hitherto been made to produce electricity for illuminating and other purposes by employing engines actuated by explosions of gas to drive the rotating armatures of electrical generators have been practically unsuccessful, for the reason that when the explosion occurs the speed of the engine, and consequently that of the armature revolved thereby, is increased, causing an increase in the current generated, while between the explosions the speed gradually declines and the current is diminished. This variation in current of course produces improper effects in the translating devices supplied from the generator; and this is especially the case when the current is employed for incandescent electric lamps, the variations of current causing constant variations in the brilliancy of the lamps.

The object I have in view is to successfully employ gas-engines in operating electric generators which supply current to electric lamps, electro-motors, or other translating devices; and to this end my invention consists in employing, in connection with a gas-engine and the generator or generators driven thereby, means operated automatically by the movement of the apparatus, to compensate for the increase of speed by reducing the proportion of the entire current generated, which is transmitted to the translating devices, such means being caused to operate at the moment when the increase of speed commences, so that practically the same current is supplied to the translating devices as before.

I prefer to employ my invention in connection with a multiple-arc system of lighting by electrical incandescence, though it may be employed with a series system and with arc-lamps or any kind of translating devices.

The generator, which is preferably a dynamo-electric machine having its field and armature coils in multiple-arc relation to each other, but which may have its field energized from an external source, is connected preferably by a belt with the shaft of the gas-engine.

Lamps or other translating devices are placed in multiple arc across main conductors leading from the machine.

Where the "Otto" or other gas-engine is used, in which an explosion occurs at every second revolution of the fly-wheel, a cam or eccentric is placed on the shaft which operates the valves, which shaft revolves with one-half the speed of the main shaft, so that the explosion occurs once during each of its revolutions. This cam or eccentric works an arm whose movement causes a decrease in the proportion of the current generated, which is supplied to the translating devices at the moment of the explosion. Such diminution may be accomplished by throwing resistance into the main circuit; but it is preferable to diminish the proportion of current in the translating devices by closing other multiple-arc circuits, (through suitable resistance,) and thus providing new paths for the current. A number of such multiple-arc circuits, all of the same resistance, may be simultaneously thrown into circuit as soon as the increase of speed occurs; but in a gas-engine the speed gradually increases after the explosion up to a certain point, and then gradually declines. Therefore I prefer to close a circuit of high resistance at the beginning of the increase, and then successively close circuits of gradually-decreasing resistance in the proper proportion until the maximum speed is reached, when the resistances are gradually increased as the speed runs down. To accomplish this I prefer to employ as resistances a number of incandescing electric lamps. One terminal of the multiple-arc circuit from the main line is connected with the circuit-controlling arm worked by the eccentric, while the other terminal is divided into a number of branches, each running to a contact-point. In each of these branches is placed one or more of the resistance-lamps, they being, if more than one is used, in multiple-arc relation to each other, so that the branch containing most lamps is the one of least resistance. The lamps are so arranged that at the first slight increase of speed a circuit containing only one lamp will be closed by the movement of the circuit-controlling arm,

while as the speed increases circuits containing two, three, or more lamps are successively closed. As the speed again declines circuits containing less numbers of lamps are closed until near the end of the first revolution. During the second revolution the decline in speed is so small and gradual that the generation of current is practically unaffected by it.

I prefer to use for opening and closing the multiple-arc branches a commutator, which consists of a number of thin metal plates set near together, but separated by plates of insulation. Each metal plate is extended out beyond the insulation and bent so that the plates diverge into a fan shape. Wires connected one to each plate run to binding-posts, from which the wires run which form the circuits including the resistance-lamps. A contact-point placed at the extremity of the circuit-controlling arm slides backward and forwark over the edges of the commutator-plates during each revolution of the valve-shaft; and a thin metal plate is so placed that it will lie between the contact-point and the commutator-plates during that half of the revolution of the valve-shaft during which no explosion occurs, while during the rest of the revolution the contact-point will pass under this plate and be in contact with the edges of the commutator-plates. Thus when the explosion occurs the contact-point, passing over the edges of the commutator-plates, will close the successive multiple-arc branches, while, when the eccentric draws such point back, it will be separated from the commutator-plates by the flat plate mentioned, and said branches are not affected.

As stated, it is preferable to vary the proportion of current supplied to the translating devices gradually. I may, however, accomplish such variation all at once, and this accomplishes the regulation in a very satisfactory manner, although not so perfectly as that just described. In this case the arm attached to the eccentric merely serves to close a circuit, which may be a multiple-arc circuit of the desired resistance, or may act as a shunt around a wire-resistance in the main line. The circuit-controller may be a point dipping into a mercury-cup, and withdrawn therefrom as the arm is moved back and forth; or the circuit may be made and broken at contact-points in any ordinary manner. With all these arrangements means are provided for adjusting the position of the eccentric so that it can be set to act at the proper point.

It is evident that the eccentric might be placed on the main shaft of the engine, on the shaft of the armature, or on any moving part of the apparatus, proper adjustment of the eccentric being made to insure its action at the proper point.

In some gas-engines the air and gas are admitted to the exploding-chamber at such times and in such proportions that the explosions occur irregularly instead of at every other revolution. With such engines an arrangement different from those described is necessary. Such arrangement consists of a spring-governor placed on the valve-shaft or any rotating portion of the engine or generator, and provided with an arm for varying a resistance placed preferably in one of the main conductors. I preferably employ the flat commutator-plates described, with wires running from them and including resistance-coils. As the speed of the engine increases upon the occurrence of an explosion, the movement of the governor throws the resistance-coils into circuit, while, as the speed declines, the contact-arm is drawn back and throws out resistance.

In the accompanying drawings, Figure 1 is a top view, representing a gas-engine, the generator driven thereby, and the compensating devices; Fig. 2, a top view of the eccentric on the valve-shaft and the resistance-commutator; Fig. 3, an elevation illustrating the devices for adjusting the eccentric; Fig. 4, a detail view, in perspective, of the resistance-commutator; Fig. 5, a diagram illustrating the variation in speed of the gas-engine and the times at which the resistance-lamps should be placed in circuit; and Figs. 6, 7, and 8 are diagrams illustrating other forms of the invention.

Referring to the first five figures of the drawings, A represents a gas-engine, B the main shaft of the same, and C the shaft which operates the valves, and is revolved from shaft B by gears *a a*, the shaft C making half as many revolutions as the shaft B. A belt, D, runs from shaft B to the armature-shaft E of a dynamo-electric machine, F. From the generator F main conductors 1 2 extend, across which translating devices *y y* are placed in multiple-arc circuits.

Upon a sleeve, G, on shaft C is mounted an eccentric, H. From the eccentric H runs a rod, I, which terminates in a contact-point, *b*.

Upon a suitable insulating-base, J, are supported edgewise and side by side the series of thin metal plates *c c*, separated by plates *d d*, of mica or other insulating material, the whole being supported and held together by an insulated bolt, *e*, passing through the plates and the standards K K. Supported also from the base J is the flat spring-piece L, which terminates in an inclined plane, *f*, located immediately above the edges of the commutator-plates *c c*.

The rod I, which is attached to the eccentric, is connected with rod M, and to rod M is attached at right angles the contact-arm N, which terminates in a point, *b*, resting on the commutator-plates *c c*. Each commutator-plate extends out beyond the insulating-plates and is bent out from the rest, the whole forming a fan shape, and to each is attached a wire, *g*, passing under the base J, each wire *g* being connected with one of the binding posts *h*. The wire 3 of a multiple-arc circuit, 3 4, from the main conductors 1 2 is connected to a binding-post, *h'*, on the base J, from which a wire,

5, runs to arm N. The wire 4 is divided into a number of branches, as seen in Fig. 1, each connected with one of the binding-posts h. Each of these branches contains one or more resistance-lamps, i, in multiple-arc relation to each other, as shown.

The operation of these devices is as follows: The explosion occuring, as stated, once during each revolution of the valve-shaft C, the eccentric is so adjusted that at the time of the explosion the contact b is in the position shown in Figs. 2 and 4. The motion of the eccentric draws the contact-point along the plates c c, under the piece f, making successive contacts and throwing into circuit first one, then two, three, and four lamps, as the speed increases, and then gradually reducing the number as the speed declines. This is clearly illustrated in Fig. 5, wherein the curve x x shows the increase and decrease of speed during two revolutions of the main shaft and fly-wheel, or one revolution of the valve-shaft, the dotted lines x' x' showing the end of the first revolution. The full vertical lines represent the points at which lamps are thrown in, the figures showing the number of lamps at each point. The decline in speed during the second revolution is so small and gradual that it is not necessary to compensate for it. It is evident that the circuit 3 4 may be divided into many more parts and lamps thrown in with much greater frequency; that more lamps may be used, if necessary, at points of greatest speed, and that at points of less speed, where a high compensating resistance is desired in the circuit, higher resistance lamps may be used, or two or more lamps in series may be thrown in. During the second half of the revolution of the valve-shaft the contact b slides forward, but now passes over the inclined plane f, and is thus kept from contact with the commutator-plates. It then drops into the position shown in Figs. 2 and 4 in time for the explosion.

The sleeve G, which carries the eccentric H, is made adjustable on shaft C by means of a forked arm, k, attached to said sleeve, pivoted at l, and moved by screwing in and out the rod m, a pin, s, on the shaft moving in a slot, t, so that the movement of the sleeve adjusts the eccentric. A pointer, n, is attached to arm k, moving on a scale, o, by which the position of the eccentric is determined. This adjustment is desirable in order that the eccentric may be made to act at precisely the proper points.

In Fig. 6, a number of resistance-lamps i are in multiple arc across the circuit 3 4. The arm I terminates in a contact-point, p, which enters a mercury-cup, q, and completes the circuit 3 4 at the moment when the explosion occurs, thus throwing the lamps i i into circuit and reducing the proportion of current supplied to the translating devices a a.

It is evident that the eccentric which moves the rod I may be attached to any revolving part of the apparatus. In Fig. 7 the motion of the arm I opens and closes circuit at r, thus throwing a resistance, R, into the main circuit when the speed increases, and closing a shunt around the resistance when the speed diminishes. In Figs. 6 and 7 the eccentric is adjusted by means of a set-screw, u.

The device illustrated in Fig. 8 is intended for use with gas-engines in which the explosive gaseous mixture is not regulated so as to explode at stated regular intervals, but explodes irregularly. A spring-governor, S, is placed on the main shaft or valve-shaft of the engine or on any other revolving part of the apparatus, and an arm, O, attached to the sleeve of said governor, acts to gradually throw the resistance R′ into the main line as the speed increases and to remove it as the speed diminishes.

With all these forms, an adjustable resistance, R^2, (shown in Fig. 1,) should be placed in the field-circuit of the generator to regulate the generation of current according to variations in the number of translating devices in circuit, or other suitable form of regulating device should be provided for this purpose.

What I claim is—

1. The combination, with a gas-engine, a dynamo or magneto electric machine driven thereby, and one or more translating devices supplied with current by said machine, of means for compensating for irregularities in the speed of said engine, whereby a practically constant electro-motive force will be maintained at the translating device or devices, substantially as set forth.

2. The combination, with a gas-engine, a dynamo or magneto electric machine driven thereby, and translating devices supplied with current by said machine, of means for controlling the supply of current to said translating devices to compensate for irregularities in the speed of said engine, so as to maintain a practically constant electro-motive force, substantially as set forth.

3. The combination, with a gas engine, a dynamo or magneto electric machine driven thereby, and translating devices supplied with current by said machine, of means actuated by a moving part of the apparatus controlling the supply of current to the translating devices to compensate for accelerations and retardations in the speed of said engine, substantially as set forth.

4. The combination, with a gas-engine, an electric generator driven thereby, and translating devices supplied by such generator, of means actuated by some moving portion of the apparatus for gradually varying the resistance of the circuit which contains the translating devices to compensate for the gradual accelerations and retardations of the speed of said engine, whereby a practically constant electromotive force is maintained, substantially as set forth.

5. The combination, with a gas-engine, an electric generator driven thereby, and trans-

lating devices supplied by such generator, of a circuit-controlling device operated by the movement of said engine, and controlling a circuit or circuits whose opening or closure varies the resistance of the circuit containing the translating devices, to compensate for irregularities in the speed of said engine, substantially as set forth.

6. The combination, with a gas-engine, an electric generator driven thereby, and translating devices supplied by said generator, of an eccentric mounted on a revolving portion of the apparatus, and a circuit-controlling device operated by said eccentric and controlling the supply of current to the translating devices, to compensate for irregularities in the speed of the engine, substantially as set forth.

7. The combination, with the gas-engine, the generator, and the translating devices, the last being arranged in multiple arc, of means actuated by the movement of the engine for closing other multiple-arc circuits when the speed of the engine increases, and opening such circuits when the speed declines, substantially as set forth.

8. The combination, with the gas-engine, the generator, and translating devices in multiple arc, of a number of multiple-arc circuits of various resistances, and means actuated by the movement of the engine for successively closing such circuits to compensate for irregularities in speed of the engine, substantially as set forth.

9. The combination, with the circuit-controlling arm carried by the eccentric operated from the shaft of the gas-engine, and the contacts made successively by said arm, of means for keeping said arm from touching said contacts during the revolutions of the shaft in which no explosions occur, substantially as set forth.

10. The combination, with the arm operated by the eccentric and carrying a contact-point which slides on the edges of thin commutator-plates, of means for keeping said point from contact with said plates during one-half of the movement of the eccentric, substantially as set forth.

11. The combination, with the eccentric-operated arm provided with a contact-point and the edgewise commutator-plates, of the spring-plate, over which said contact-point passes in one direction, but under it in the other, substantially as set forth.

12. The combination, with a gas-engine, a dynamo or magneto electric machine driven thereby, and translating devices supplied with current by said machine, of adjustable means for compensating for irregularities in the speed of said engine, whereby a practically constant electro-motive force will be maintained at the translating devices, substantially as set forth.

13. The method of maintaining a constant electro-motive force at the translating devices in a system of electrical distribution whose generator is actuated by an intermittently-operating motor, consisting in varying the proportion of the entire current generated, which is supplied to said translating devices to a degree corresponding to the curve of acceleration and retardation of the speed of said motor, the proportion of current sent to the translating devices being diminished when the speed increases, and vice versa, substantially as set forth.

This specification signed and witnessed this 20th day of December, 1882.

THOS. A. EDISON.

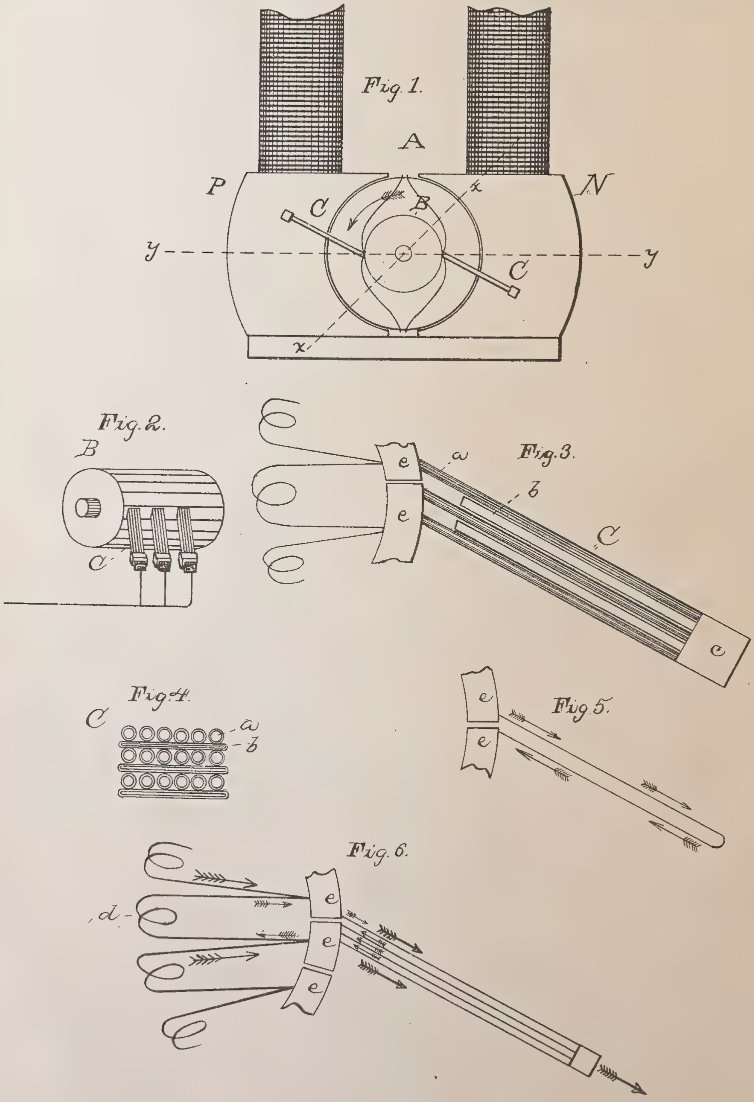
Witnesses:
H. W. Seely,
Wm. H. Meadowcroft.

(No Model.)

T. A. EDISON.

ELECTRICAL GENERATOR AND MOTOR.

No. 276,233. Patented Apr. 24, 1883.



ATTEST:

E. C. Rowland,

V. H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer

Atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRICAL GENERATOR AND MOTOR.

SPECIFICATION forming part of Letters Patent No. 276,233, dated April 24, 188

Application filed November 23, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Generators and Motors, (Case No. 517,) of which the following is a specification.

In the working of continuous-current dynamo-electric machines or electro-dynamic motors the increase of the load of such machines causes the neutral line, or the line where there is the least spark, to advance in the direction of rotation, (away from the line of maximum electro-motive force or work,) which I have found is always located on the armature centrally between the polar extensions of the field-magnet. It has been found necessary heretofore to shift the commutator-brushes or current-collectors forward to the neutral line in order to prevent destructive sparks, which are due to the cutting of lines of force produced by the polarity of the armature-core, caused by the current flowing through the armature-coils; but the removal of the brushes away from the line of maximum electro-motive force of the generator reduces the electro-motive force of the machine. With electro-dynamic motors the difficulties are greatly increased, since the load may vary frequently, and, if the brushes are adjusted for the average load, the shifting of the neutral line away from the brushes will be productive of undue sparking, destructive both of the commutator and the brushes.

The object, therefore, of this invention is to produce means whereby the current-collectors or commutator-brushes may be retained at the points of maximum electro-motive force or work of the generator or motor without undue or destructive sparking, the capacity of the machines being thereby largely increased.

It has been the universal practice heretofore to use for the commutator-brushes of machines of this character copper or other metal having good electrical conductivity and making good electrical contact. I have found that the copper brushes, by reason of their great conductivity and good contact, form circuits of very low resistance between the bars of the commutator as they pass over them, and hence short-circuit in succession the coils connecting the pairs of commutator-bars, such coils then forming a local dynamo and generating a powerful local current. The breaking of that short circuit, which takes place when the brushes leave a commutator-bar, causes the destructive spark. The generation of the powerful local currents also causes the heating of the machine and the loss of energy due to such heating.

I reverse the practice heretofore followed, and provide current-collectors of inferior electrical conductivity and contact, compared with copper, so that the bridge formed by each collector across the commutator-bars will have a large resistance compared with the local coils, the circuit of which is completed within the machine by the bridging of the commutator-bars; hence the local current will be very weak and the spark comparatively nothing. With current-collectors of this character I am enabled to keep the collectors at the points of maximum electro-motive force or work, notwithstanding these may not be the neutral points, and by providing a number of such collectors I can get the requisite total conductivity and contact to carry the main current without sparking. The current-collectors, whether in the form of wire brushes, plate-springs, or of other form, are made of some metal or alloy having inferior conductivity, and making inferior contact compared with copper, and preferably having a high melting-point. Nickel, iron, steel, cobalt, platinum, or palladium might be used, or alloys, such as phosphor-bronze or brass; but I prefer to use German silver for the purpose, for the reason that it offers very great resistance and does not lose its stiffness by heat, as most alloys do. The current-collectors, when made as brushes, are made up of layers of wires, which are preferably separated by metal plates, the whole being soldered together into a solid mass at one end. To increase the resistance of the bridge formed by the brush, the layers of wire are preferably insulated from each other. This may be done by japanning the separating metal plates. The wires themselves may also be japanned and the separating-plates omitted or not, as desired. The separating japanned metal plates may be replaced by strips of mica or other suitable insulating material; but the japanned metal is preferred.

The brush has its end bearing on the com-

mutator-cylinder, the ends of all or nearly all the wires being in contact therewith. The current, in passing from one bar to another through the brush, is forced to travel up part of the wires to the solid end of the brush and then down other wires to the other bar, the resistance of the length of the wires being interposed in the local circuit. The high resistance is due not only to the resistance offered by the metal of the current-collectors, but largely to the inferior electrical contact of the collectors on the commutator-cylinder, which occurs when metals or alloys having a conductivity inferior to copper are used for the collectors. The contact-resistance may be further increased by constructing the commutator-bars or surfacing them with such a metal or alloy as has been described, making an inferior electrical contact compared with copper. In addition to the local sparking, there is the sparking due to the taking off of the main current. This latter sparking is of course increased by the inferior contact made by the current-collectors. The sparking due to the main current can be prevented by increasing the number of collectors or the component parts of the collectors to such an extent that the spark due to the main current will be reduced to the minimum by division.

In the accompanying drawings, Figure 1 illustrates a dynamo-electric machine or electro-dynamic motor with commutator-brushes arranged in accordance with my invention; Fig. 2, a view of the commutator, showing several brushes; Fig. 3, a view on a larger scale of two bars of a commutator and the improved brush; Fig. 4, a cross-section of the brush; Fig. 5, an illustration of the course taken by the local current through the electrically-divided brush, and Fig. 6 an illustration showing the course of the local and main currents.

P N, Fig. 1, are the polar extensions of the field-magnet of the generator or motor, A being the armature; B, the commutator-cylinder, and C C the commutator-brushes. The varying neutral line on the commutator-cylinder is represented by the dotted line $x\ x$ and the line of maximum electro-motive force by the dotted line $y\ y$. The armature-coils are connected with the commutator-bars at intermediate points, as indicated by the lines in Fig. 1, bringing the points of maximum electro-motive force on the commutator opposite the center of the polar extensions of the field-magnet. The lines $x\ x$ and $y\ y$ correspond with the neutral line and the line of maximum electro-motive force on the commutator, and are perpendicular to corresponding lines on the armature.

Heretofore, in order to prevent sparking, it has been found necessary to shift the brushes onto the line $x\ x$; but I am enabled by the peculiar construction of my brushes and the commutator-bars (either or both) to keep them on line $y\ y$ without sparking. Two or more commutator-brushes connected together are used on each side of the commutator-cylinder to carry the current, as shown in Fig. 2. Each brush may be constructed of layers of wires *a*, of German silver or other inferior conducting metal or alloy, the layers being divided by metal plates or strips *b*.

The wires *a* and plates *b* are formed into a solid mass by soldering at the outer end, *c*, of the brush. The plates *b* are japanned, as are also the wires *a*, so as to insure a good electrical division of the brush. The brush rests with the ends of all its wires bearing on the commutator-cylinder, as shown. The course of the local current is indicated by the small arrows in Figs. 5 and 6, while the course of the main current is indicated by the large arrows in Fig. 6.

The local coil *d*, Fig. 6, has its circuit closed at the commutator by the bridge formed by the brush. This bridge, however, is of high resistance compared with the coil *d*. It is made so by the inferior electrical contact of the brush on the commutator by the inferior conductivity of the metal of which the brush is made, and also by the electrical division of the brush at its inner or bearing end.

It will be noticed that the local current, in addition to being forced to overcome the resistance offered by the length of the wires, has to overcome the main current in one side of the bridge formed by the brush.

The bars *e* of the commutator B may also be made of or surfaced with German silver or other suitable alloy or metal, making inferior electrical contact compared with copper. This increases the resistance of the contact and makes the bridges formed by the brushes of higher resistance.

What I claim is—

1. The combination, with an electrical generator or motor, of current-collectors, each forming a bridge of high resistance between the bars of the commutator, substantially as set forth.

2. The combination, with an electrical generator or motor, of current-collectors making inferior electrical contact at the commutator-cylinder of said generator or motor, substantially as set forth.

3. A current-collector for electrical generators or motors, made of inferior conducting material, substantially as set forth.

4. In an electrical generator or motor, the combination, with the commutator, of current-collectors divided electrically at their bearing ends in the direction of the motion of the commutator, whereby the collectors will form bridges of high resistance between the commutator-bars, substantially as set forth.

5. A current-collector for electrical generators or motors, made of inferior conducting material and divided electrically, substantially as set forth.

6. The combination, with an electrical generator or motor, of a commutator-cylinder having its bars made of or surfaced with a material making inferior electrical contact with the current-collectors, substantially as set forth.

7. In an electrical generator or motor, the combination, with the commutator-cylinder, of the current-collectors, the bars of said commutator-cylinder and said collectors being both constructed of or surfaced with a material making inferior electrical contact, substantially as set forth.

8. In an electrical generator or motor, the combination, with the commutator-cylinder, of a number of current-collectors, each offering a high resistance to the local current, and having a combined contact and conductivity sufficient to carry the main current, substantially as set forth.

9. A current-collector made of German silver, substantially as set forth.

10. A commutator having its bars made of or surfaced with German silver, substantially as set forth.

11. A commutator-brush constructed of wires arranged in layers, the several layers being insulated from each other at the bearing end of the brush, substantially as set forth.

12. A commutator-brush constructed of wires, the separate wires being all insulated from each other at the bearing end of the brush, substantially as set forth.

This specification signed and witnessed this 14th day of November, 1882.

THOS. A. EDISON.

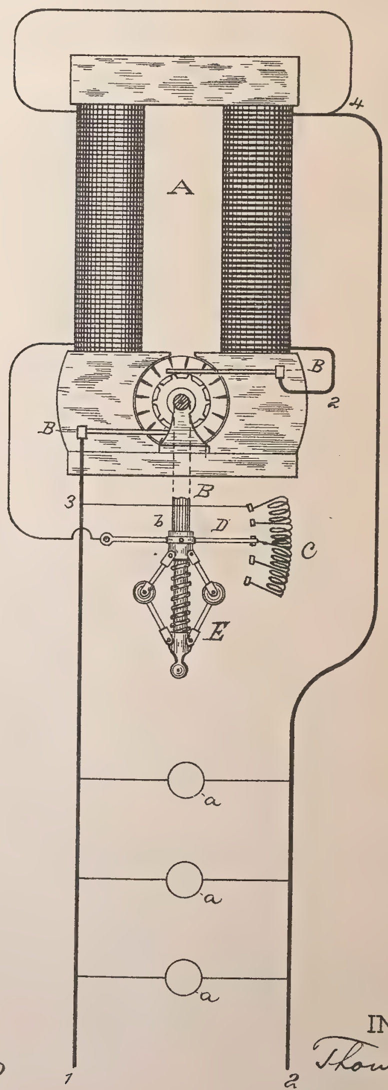
Witnesses:
WM. H. MEADOWCROFT,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 278,413. Patented May 29, 1883.



ATTEST:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison
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Atty.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES

SPECIFICATION forming part of Letters Patent No. 278,413, dated May 29, 1883.

Application filed December 8, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulators for Dynamo-Electric Machines, (Case No. 521,) of which the following is a specification.

In my application No. 72,523 is set forth a method of regulating a dynamo-electric machine by placing a portion of its coils, formed of coarse wire, in the main circuit, and the remaining portion, composed of fine wire, in a multiple-arc circuit therefrom, whereby variations in the number of translating devices in circuit, by oppositely varying the current in the two portions in proper proportions, regulated the generation of current by the machine according to the requirements of the system.

My present invention relates to an improvement upon regulators of this kind, which regulate only for variations in number of translating devices, by which improvement I am enabled to regulate for variations in the speed of the armature, as well as for differences in the number of translating devices in circuit.

Such invention consists in combining with a dynamo-electric machine, having its field-magnet coils so connected that variations in current on the main line vary directly the energy of the magnet, mechanical means operated by variations in speed of the armature to regulate the current energizing the field-magnet, as required by such variations.

A simple and convenient manner of carrying out my invention consists in winding the field-magnet as above described, and placing in the multiple-arc circuit, which includes the fine-wire coils, a resistance adjustable by means of an arm carried by a spring-governor placed on the shaft of the armature, or attached to any other revolving portion of the apparatus. Such governor acts to throw out resistance when the speed of the armature is diminished, and to increase the resistance if the speed is too much increased.

My invention is illustrated in the accompanying drawing, which is a view partly in diagram of a dynamo-electric machine with the accompanying devices and circuits.

A is the field-magnet, and B B are the commutator-brushes, from which main conductors 1 2 lead in multiple-arc circuits, from which are placed lamps or other translating devices, *a a*. Conductor 2 is wound around one limb of magnet A, as shown, and a multiple-arc circuit, 3 4, of finer wire, includes the other limb; or the fine-wire circuit 3 4 could cover both limbs, and the coarse wire be wound above the whole, or a portion of it.

For convenience in drawing, a top view of the speed-regulating devices is shown, a portion of the armature-shaft B being shown in dotted lines.

C is an adjustable resistance in the circuit 3 4, and D an arm connected in said circuit for varying said resistance. The arm D is attached to the sleeve *b* of spring-governor E, attached to the armature-shaft B.

If the number of lamps or other translating devices in multiple arc in the system is increased, an increase of current is caused in the conductor 2 and a decrease in the fine-wire circuit 3 4, the excess of the increase over the decrease producing the proper increase in the energy of the field-magnet to meet the requirements of the additional number of translating devices. An opposite effect is produced by the removal of such devices. An increase in the speed of the motor which drives the armature of the machine would cause the generation of too much current for the system, and also would increase the current in both portions of the coils of the field-magnet, so that the generation of current would continue to increase. I therefore provide the governor E, which, when the speed of the armature increases, moves the arm D so as to increase the proportion of resistance C in the fine-wire circuit 3 4, thus decreasing the energy of the magnet and diminishing the generation of current to compensate for the increase caused by the increase of speed. An unusual decrease of speed causes the governor E to move the arm D in the other direction, so as to decrease the resistance C. The two regulators in combination, it will be seen, are sufficient to regulate for all the conditions of inequality of generation which can occur. It is evident that the same effect will be produced if the governor E is mounted on any other revolving portion of the apparatus and properly connected.

In my Patent No. 264,665 mechanical means

actuated by variations in speed are shown in connection with an electro-magnet in the main line, both acting upon an adjustable resistance, in the field-circuit of a generator. In this case the addition or removal of translating devices by varying the energy of the magnet in the main line, and thus adjusting the resistance, causes variations in the current in the field-magnet of the machine. By my present invention, however, I dispense with the regulating electro-magnet and place part of the coils of the field-magnet in the main circuit, so that the energy of such field-magnet is directly influenced and varied by changes in the number of translating devices in circuit, and it is to connections producing such direct variations that this invention is limited.

What I claim is—

1. The combination, with a dynamo-electric machine, of connections with its field-magnet coils, whereby variations in current in the main line, caused by the addition and removal of translating devices, act directly upon said field-magnet to vary its energy, and mechanical means operated by variations in the speed of the armature for varying the current energizing said magnet, substantially as set forth.

2. The combination of a dynamo-electric machine having a portion of its field-magnet coils included in the main circuit, translating devices arranged in multiple arc from said main circuit, a multiple-arc circuit, including the remaining portion of such field-magnet coils, and mechanical means operated by variations in the speed of the armature, and varying the current in said multiple-arc circuit, substantially as set forth.

3. The combination of a dynamo-electric machine having a portion of its field-magnet coils so connected that variations in current in the main line, caused by the addition and removal of translating devices, vary directly the energy of the magnet, a centrifugal governor, and an adjustable resistance varied by said governor to regulate the current in the remaining portion of said field-magnet coils according to variations in the speed of the armature, substantially as set forth.

4. The combination, with a dynamo-electric machine having a portion of the coils of its field-magnet included directly in the main circuit and the remainder in a multiple-arc circuit therefrom, and translating devices arranged in multiple arc, of a centrifugal governor acting to vary the resistance of said multiple-arc circuit according to variations in the speed of said armature-shaft, substantially as set forth.

This specification signed and witnessed this 28th day of November, 1882.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

E. H. PYATT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 278,414. Patented May 29, 1883.

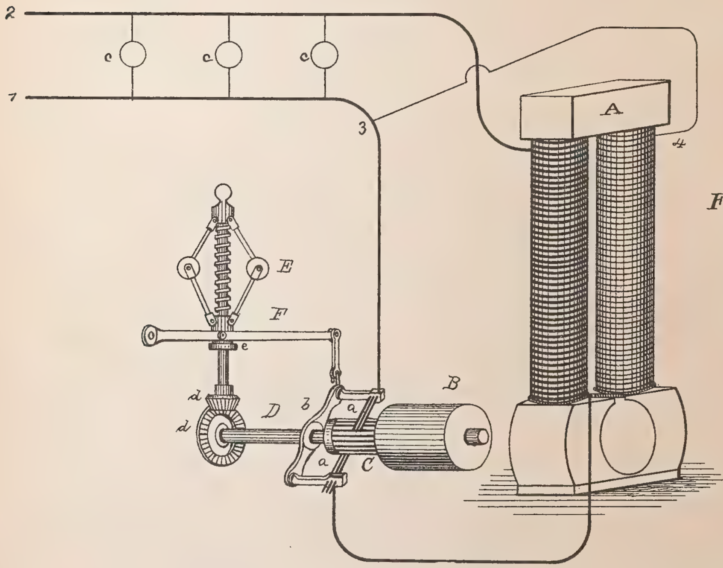


Fig. 1.

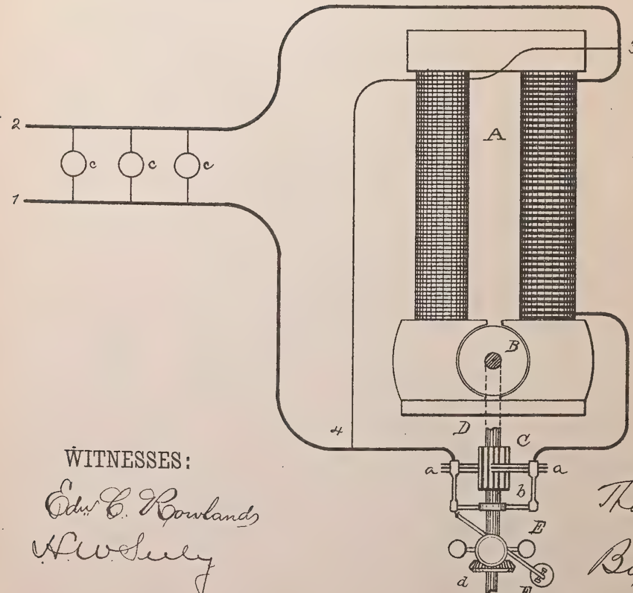


Fig. 2.

WITNESSES:

Edw. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Richd. N. Dyer.
Atty.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 278,414, dated May 29, 1883.

Application filed December 8, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulators for Dynamo-Electric Machines, (Case No. 522,) of which the following is a specification.

My invention relates to an improvement on the regulator described in my application No. 72,523, wherein a dynamo-electric machine is shown having a portion of the coils of its field-magnet included directly in the main circuit from the machine and the remaining portion in a multiple-arc circuit from said main circuit, differences in the number of translating devices connected in multiple arc with the machine by varying the current in the two sets of coils oppositely, but in different proportions, properly regulating the generation of current by the machine. Variations in speed of the armature are, however, not compensated for in a regulator of this kind; and my present invention consists in combining with such a regulator means actuated by variations in the speed of the armature for varying the position of the commutator-brushes, so as to regulate the generation of current according to such variations in speed.

My invention is illustrated in the accompanying drawings, wherein Figure 1 is a view in perspective of a dynamo-electric machine embodying my invention, the armature being, for convenience, shown apart from the field-magnets, and the circuits being shown diagrammatically; and Fig. 2 represents the machine in elevation, with a top view of the brush-adjusting devices.

A is the field-magnet, B the armature, and C the commutator-cylinder, of the machine. The commutator-brushes *a a* are attached to a yoke, *b*, pivoted on the shaft D. Main conductors 1 2 extend from the commutator-brushes, and translating devices *c c* are placed in multiple arc across said conductors. A part of the field-magnet coils are included in the main circuit 1 2, as shown, while the remainder are in a multiple-arc circuit, 3 4, of finer wire; and the generation of current is regulated according to variations in the number of translating devices by the effect produced in the field-coils by such variations, as explained in the application above referred to. A spring-governor, E, is revolved from the armature-shaft D through gears *d d*, though it may be connected with said shaft by other suitable means. The sleeve *e* on the governor-shaft is connected to arm F, which is attached to the pivoted yoke *b*, which holds the commutator-brushes. It is evident that an increase in the speed of the motor which drives the armature will cause the raising of the arm F, which moves the commutator-brushes *a a*, so as to decrease the current taken from the machine, while a decrease in speed will produce an opposite result.

What I claim is—

1. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of connections whereby variations in current caused by variations in the number of said translating devices in circuit act directly upon the field-magnet of the machine to vary its intensity, and means actuated by variations in speed of the armature for shifting the commutator-brushes of the machine to compensate for such variations, substantially as set forth.

2. The combination, with a dynamo-electric machine having a portion of its coils included in the main circuit and translating devices arranged in multiple arc, of means actuated by variations in the speed of the armature for shifting the commutator-brushes to compensate for such variations, substantially as set forth.

3. The combination, with a dynamo-electric machine having a portion of its coils included in the main circuit and translating devices arranged in multiple arc, of a governor revolved by the armature-shaft and connected to the commutator-brushes, substantially as set forth.

This specification signed and witnessed this 28th day of November, 1882.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
E. H. PYATT.

(No Model.)

T. A. EDISON.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

No. 278,415. Patented May 29, 1883.

Fig. 1.

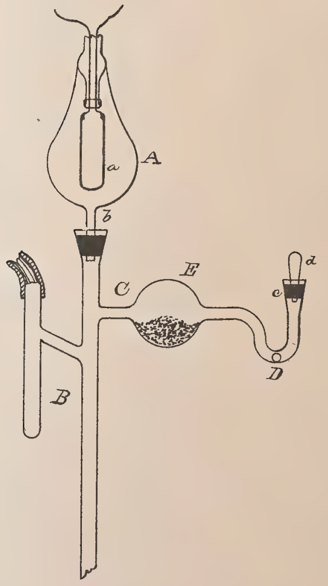


Fig. 2.

ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Richd N. Dyer

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 278,415, dated May 29, 1883.

Application filed January 22, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescing Electric Lamps, (Case No. 537,) of which the following is a specification.

The object of this invention is to provide a simple and convenient method of decreasing the resistance of the carbon filament of an incandescing electric lamp, which it is often desirable to do when a filament after carbonization is found to be of so much higher resistance than others that it cannot be used in the same system.

In carrying out my invention I attach to the vacuum apparatus by which the lamp-globe is exhausted a tube having its other end open, an air-tight stopper being provided for closing it when desired. I inclose within an envelope of gelatine or other suitable substance a quantity of a volatile carbon or silicon compound sufficient to reduce the resistance of the particular filament under treatment to the proper point. Suitable compounds for the purpose are chloride of carbon, chloroform, or the volatile chlorides of silicon. Said envelope should consist of such a substance that the application of heat will cause it to open either by melting or by bursting from the expansion of the inclosed liquid, such substance also not being chemically affected by the substance inclosed by it. Other suitable materials than that mentioned are collodion, fusible metal, lead, and tragacanth. The capsule thus formed is dropped into the open end of the tube, a portion of which is formed to receive it. After the lamp is exhausted heat is applied externally to this portion of the tube, when the external envelope is destroyed, and the carbon or silicon compound is freed and volatilizes, the vapor entering the globe and depositing carbon or silicon upon the filament, which is at this time heated to incandescence by an electric current. Such deposition of carbon or silicon reduces the resistance of the filament to the proper point.

The apparatus described is illustrated in Figure 1 of the annexed drawings, Fig. 2 being a sectional view of the capsule used.

A represents the inclosing-globe, and *a* the flexible carbon filament, of an incandescing electric lamp. The globe is provided with an exhaust-tube, *b*, which is attached to the Sprengel vacuum apparatus B. A tube, C, is connected with said vacuum apparatus, having an open end, a rubber stopper, *c*, with a handle, *d*, being provided to close said opening.

D is the capsule, consisting of an envelope, *e*, of a substance readily affected, as described, by heat, and not chemically affected by the volatile carbon or silicon compound *f*, which is inclosed by it. I find this mode of introducing the carbon or silicon to be a convenient one, because I can thus employ precisely the desired amount, and because if the volatile liquid was introduced in a free state it would volatilize under the decrease of atmospheric pressure and pass off through the pump, while the outer envelope protects it until the proper time. Such envelope should be of sufficient strength to withstand the pressure from within until the external heat is applied. The capsule is dropped into the tube, which is then closed by the stopper, and the lamp and tube are exhausted, after which the action of the exhausting apparatus is stopped and heat applied to the tube. The inclosing-envelope of the capsule is destroyed either by melting or by the expansion of the vapor within it, and such vapor then enters the globe. The filament *a* is heated to incandescence by an electric current, and the vapor is decomposed, depositing carbon or silicon upon said filament, the resistance of the filament being thus reduced.

The bulb E contains phosphoric anhydride or other drying agent.

I do not claim herein the capsule, such as described, as I propose to make this the subject of a separate application for Letters Patent.

What I claim is—

1. The method of reducing the resistance of the carbon filament of an incandescing electric lamp, consisting in introducing into a receptacle connected with said lamp a sufficient quantity of a volatile carbon or silicon compound, exhausting said lamp while such compound is prevented from volatilization, and then causing the volatilization of such com-

pound, at the same time heating the filament to incandescence by an electric current, substantially as set forth.

2. The method of reducing the resistance of the carbon filament of an incandescing electric lamp, consisting in first exhausting said lamp and then applying heat to a capsule such as described placed in a receptacle connected with said lamp, said filament being at the same time heated to incandescence by an electric current, substantially as set forth.

This specification signed and witnessed this 13th day of January, 1883.

THOS. A. EDISON.

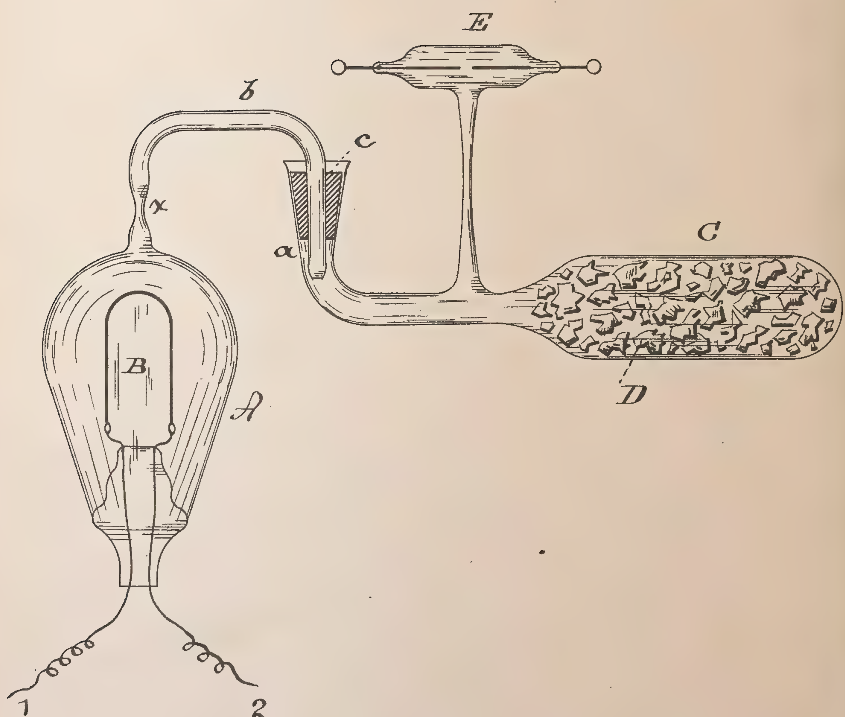
Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

No. 278,416. Patented May 29, 1883.



WITNESSES:

O. D. Mott

H. W. Seely

INVENTOR:

T. A. Edison

BY Richd. N. Dyer.

ATTORNEY

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 278,416, dated May 29, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescing Electric Lamps, (Case No. 400;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object I have in view is to produce a simple and efficient process and means for exhausting and completing incandescing electric lamps, so as to save the expense of the great number of Sprengel pumps which have to be used at present on account of the necessity of slowly treating the incandescing conductor of each lamp to drive the occluded gases therefrom.

The process consists, generally, in utilizing for this purpose an absorbent of gases contained in a chamber with which the lamp is connected, the incandescing conductor of the lamp being gradually heated by the passage of an electrical current therethrough after a sufficiently high vacuum has been obtained, and such incandescing conductor being finally brought up to a higher incandescence than that at which it is intended to be used commercially. The absorbent I prefer to use is charcoal, which is contained by a chamber adapted to be highly heated to drive the air out of the charcoal. The neck of this chamber is adapted for connection with the lamp by a rubber-packed joint, and is provided with a spark-gage to enable the condition of the vacuum to be ascertained. The lamp is first heated externally to drive as much air therefrom as possible, and it is then connected with the charcoal-chamber, which has been previously heated to a high degree, both the lamp and charcoal-chamber being hot at the time they are connected. The charcoal as it cools absorbs the air, and when a sufficiently high vacuum is obtained, which is ascertained by means of the spark-gage, the lamp is connected in an electric circuit and its incandescing conductor is slowly heated, throwing off the occluded gases, which are also absorbed by the charcoal. The conductor is finally brought up to higher incandescence than that at which it is intended to be used, so as to drive the air out of the clamps as far as possible. The lamp is then sealed off from the tube leading to the charcoal-chamber. The charcoal is again heated and the tube connected with another heated lamp, the operation being repeated, as before explained.

By this process mercury vacuum-pumps can be dispensed with, although in some instances a steam-operated vacuum-pump might be used with economy to partially exhaust the lamp before it is connected with the charcoal-chamber.

I may use also, in addition to the absorbent of gases, a suitable drying substance—such as phosphoric anhydride—which can be placed in the chamber with the charcoal and will absorb the aqueous vapor in the lamp. Previous to being connected with the chamber containing the gas-absorbent the lamp may be filled with an atmosphere of hydrochloric-acid gas, hydrobromic-acid gas, or ammoniacal gas, so as to displace as far as possible the air therein. The charcoal absorbs this gas without losing very greatly its capacity to absorb air, and a better vaccum may by its use be obtained.

The rubber-packed joint may also be dispensed with by extending the neck of the charcoal-chamber and sealing it directly to the globe of the lamp, or to a tube leading therefrom.

In my Patent No. 248,428 I describe the use of heated charcoal in connection with a mercury vacuum-pump for exhausting incandescing electric lamps; but in that instance the charcoal was used as auxiliary to the mercury-pump, while by my present invention I dispense altogether with such pumps.

The foregoing will be better understood from the drawing, which represents the principal parts of the apparatus used in carrying out the above-described process.

A is the globe of an incandescing electric lamp, having carbon filament B, to which are connected the leading-in wires 1 2. These are connected to form, with the carbon, a part of an electric circuit. C is a chamber, preferably of glass, containing charcoal D. The neck *a* of this chamber is connected with the lamp by tube *b* and rubber packing *c*. E is the spark-

gage for ascertaining the condition of the vacuum. The lamp is sealed off at x.

What I claim is—

1. The process of exhausting an incandescing electric lamp, consisting in first removing the air from a chamber containing an absorbent of gases, connecting the lamp with such chamber, heating the incandescing conductor by an electric current when the vacuum becomes sufficiently high, and then sealing off the lamp from connection with said chamber, substantially as set forth.

2. The process of exhausting an incandescing electric lamp, consisting in heating the lamp and also a chamber containing an absorbent of gases, then connecting the two while hot, and finally heating the incandescing conductor by the passage of an electric current therethrough previous to sealing off the lamp, substantially as set forth.

3. In apparatus for producing vacua, the combination, with a chamber containing a gas-absorbing material, of means connected therewith for ascertaining the degree of exhaustion, substantially as set forth.

4. The process of producing a high vacuum, consisting in displacing the air in the chamber to be exhausted by another gas, (such as hydrochloric-acid gas, hydrobromic-acid gas, or ammonia-gas,) and then connecting such chamber with another chamber containing a substance which readily absorbs such gas, substantially as set forth.

This specification signed and witnessed this 28th day of February, 1882.

THOMAS A. EDISON.

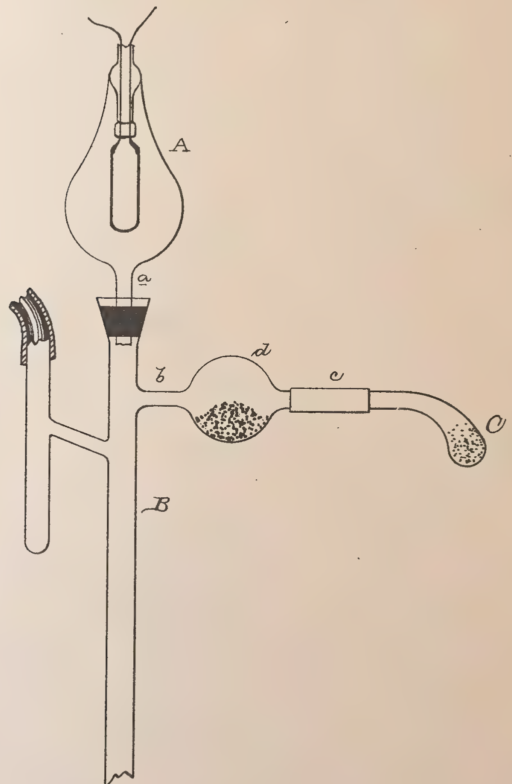
Witnesses:
H. W. SEELY,
THOMAS JOHNSTON.

(No Model.)

T. A. EDISON.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

No. 278,417. Patented May 29, 1883.



ATTEST:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison
By Rich^d N. Dyer,
Atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MANUFACTURE OF INCANDESCING ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 278,417, dated May 29, 1883.

Application filed January 22, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescing Electric Lamps, (Case No. 536,) of which the following is a specification.

In my application No. 516 (Serial No. 77,526) is described an incandescing electric lamp whose inclosing-globe contains nitrogen at a pressure which prevents electrical carrying from the carbon incandescing conductor.

The object of my present invention is to provide a simple, economical, and efficient method of introducing such a nitrogen atmosphere into such lamp-globes, the nitrogen admitted being pure and free from moisture, such method being also applicable when it is desired to charge any vessel or receptacle with any gas in a pure and dry condition.

In applying my invention to the purposes for which it is preferred, the nitrogen is evolved by heating a dry salt containing nitrogen, such as the nitrite of ammonia, or nitrite of potassium, or nitrite of chromium; or certain mixtures may be used which include such nitrites—for instance, a mixture of potassic nitrite and chloride of ammonia. The substances, when heated, give off pure nitrogen. The lamp-globe, when ready for exhaustion, is placed in connection with a Sprengel vacuum apparatus, from the exhaust-tube of which extends a tube which terminates in a bulb or chamber in which is placed the dry salt containing nitrogen. The lamp and also this bulb or chamber are then exhausted by the vacuum apparatus, with which both are connected, to as nearly complete a vacuum as possible, after which the action of said apparatus is stopped and the bulb or chamber is heated by a lamp, or in any suitable way. The compound is decomposed, and the nitrogen given off flows through the tube and into the lamp until the desired pressure is obtained, after which the lamp is sealed off. A portion of the tube through which the nitrogen flows, and which is exhausted with the rest of the apparatus, contains phosphoric anhydride or other drying agent to take up the water of crystallization of the dry salt, the gas which enters the globe being thus free from moisture.

A convenient apparatus is illustrated in the annexed drawing.

A is the inclosing-globe of an incandescing electric lamp, provided with an exhaust-tube, *a*, which is connected with the Sprengel vacuum-pump B. From this pump extends a tube, *b*, to which is connected by a rubber section, *c*, or in any other suitable manner, a tube terminating in a bulb, C, which contains one of the substances or mixtures previously mentioned, or other equivalent substance or mixture. The tube *b* is provided with a bulb, *d*, which contains phosphoric anhydride or other drying agent. The operation of the apparatus is as before explained, the lamp being finally sealed off at *a*.

It is evident that this invention may be employed in charging any receptacle with any gas by heating a dry compound placed in said receptacle, which compound is decomposable by heat into the gas required, and said receptacle being first exhausted.

What I claim is—

1. The method of charging a receptacle with pure gas, consisting in exhausting said receptacle to a high vacuum, and then heating a dry compound decomposable by heat into the gas required, said compound being placed within said receptacle, substantially as set forth.

2. The method of providing the exhausted inclosing-globe of an incandescing electric lamp with an atmosphere of pure nitrogen, consisting in heating a dry salt capable of giving off nitrogen when decomposed by heating, placed in an exhausted receptacle connected with said lamp-globe, substantially as set forth.

3. The method of providing the inclosing-globe of an incandescing electric lamp with an atmosphere of pure nitrogen, consisting in exhausting said globe and simultaneously exhausting a receptacle connected therewith and containing a dry salt containing nitrogen and decomposable by heat, and then heating said receptacle, substantially as set forth.

This specification signed and witnessed this 13th day of January, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

EDWARD H. PYATT.

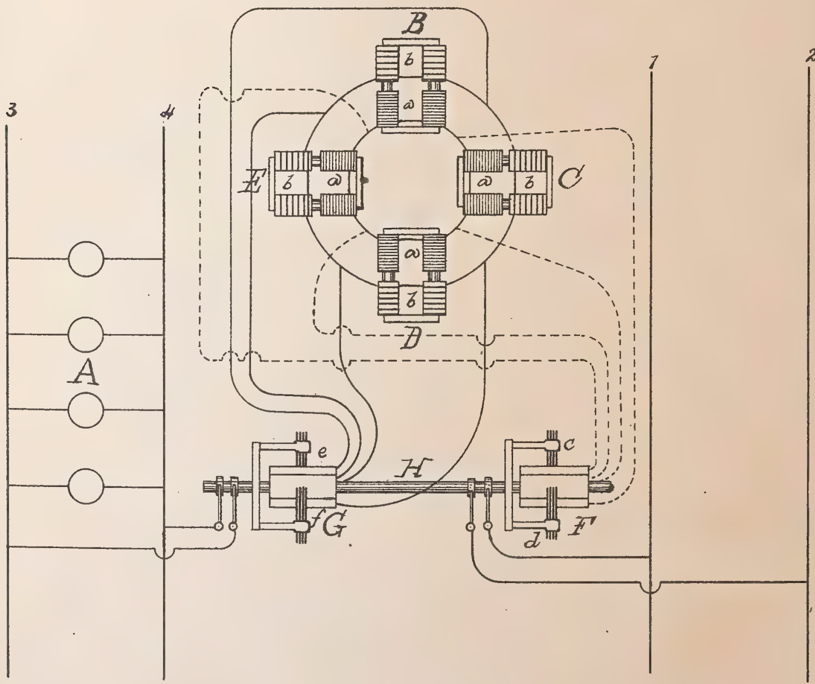
(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

APPARATUS FOR TRANSLATING ELECTRIC CURRENTS FROM HIGH TO LOW TENSION.

No. 278,418. Patented May 29, 1883.

Fig. 1.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer, Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

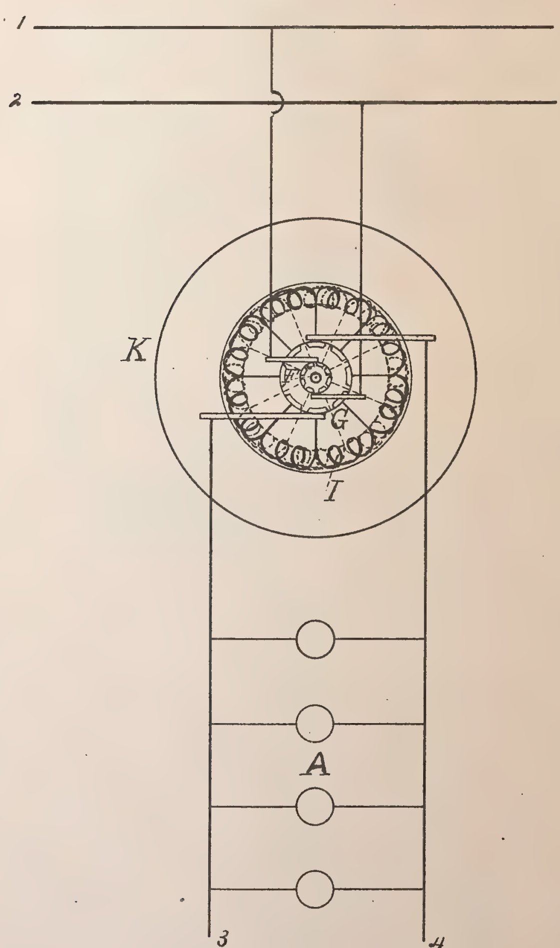
(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

APPARATUS FOR TRANSLATING ELECTRIC CURRENTS FROM HIGH TO LOW TENSION.

No. 278,418. Patented May 29, 1883.

Fig. 2.



WITNESSES:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer,
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

APPARATUS FOR TRANSLATING ELECTRIC CURRENTS FROM HIGH TO LOW TENSION.

SPECIFICATION forming part of Letters Patent No. 278,418, dated May 29, 1883.

Application filed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electric Lighting, (Case No. 463;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to produce simple and efficient means for reducing the tension of a continuous current flowing in a main circuit, and supplying consumption-circuits with a continuous current of lower tension, whereby a large saving can be made in the investment for conductors by using small main conductors, and obviating excessive loss of energy by the use of a current of high tension in the main circuit, while lamps, motors, or other translating devices requiring a continuous current can be supplied, and by the use of a current of lower tension in the consumption-circuit the translating devices can be placed in separate multiple-arc circuits and made independently controllable.

The object is accomplished by the use of induction apparatus located between the main circuit and the translating devices and transforming a continuous current of high tension into a continuous current of lower tension by the employment of a magnetic core or cores having two sets of wire coils, one of high resistance connected with the main circuit, and one of lower resistance connected with the consumption-circuit, the connections of the main and consumption circuits with their respective sets of coils being changed or advanced simultaneously, so that the inductive action of the magnetic core or cores will cause current to flow in the consumption-circuit always in the same direction.

In carrying out the invention a number of magnetic cores are preferably employed, which cores are preferably arranged in pairs to form horseshoe-magnets and have plates closed upon their poles. These magnetic cores are wound with two sets of wire placed on different portions of the cores or coiled one upon the other on the same portions of the cores. One set of coils is of high resistance, while the other set is of lower resistance, and each set of coils is connected in a closed circuit independent of the circuit of the other set. The closed circuit of each set of coils is connected with the bars or plates of a stationary commutator-cylinder at points between the pairs of magnetic cores, there being a bar on each commutator-cylinder for each pair of magnetic cores. Upon each commutator-cylinder travels a pair of commutator brushes or springs. These commutator-brushes are mounted upon a common shaft, which is revolved by any suitable means, an electromotor being used for the purpose, or a spring or weight actuated mechanism. The brushes traveling on the commutator-cylinder connected with the coils of high resistance are connected with the main circuit, while the brushes traveling on the commutator connected with the coils of low resistance are connected with the consumption-circuit. The current in the fine-wire or high-resistance coils flows from one commutator-brush to the other in two directions, one-half the pairs of cores having their coils receive current in one direction, while the other half of the cores have their coils receive current in the opposite direction. Now, the revolution or the commutator-brushes will cause the pairs of magnetic cores to have the connections of their coils reversed two at a time, thus causing a reversal of magnetic polarity. This change in magnetic polarity induces a current of lower tension in the coarse or low-resistance coils, the connections with which being advanced simultaneously with those of the fine-wire coils, the induced current is made a continuous current, or a current flowing in one direction. The action may perhaps be better illustrated by considering the points at which the current flows into and leaves the closed circuit of the fine-wire coils as in the neutral line. This is advanced by the revolution of the commutator-brushes, and the opposite pairs of magnetic cores are crossed by the line simultaneously. The same result would be produced if the magnetic cores were mounted upon a shaft and revolved with the commutator-cylinders, the commutator-brushes being held stationary.

Instead of using a number of double-wound magnetic cores, a single annular core can be used, similar to a Gramme ring, the annular core being provided with two sets of continuously-wound wire coils, one of high resistance and the other of low resistance, connected at intervals to the bars of separate commutator-cylinders.

The coils of high resistance are connected through the commutator and brushes with the main circuit, while the coils of low resistance are similarly connected with the consumption-circuit. The double-wound ring and the commutator-cylinders may be revolved, and the commutator brushes or springs held stationary; or the commutator-brushes may be revolved together and the ring and cylinders held stationary. The double-wound ring is perferably surrounded by a ring of iron to carry the magnetism between the ends of the neutral line.

The foregoing will be better understood from the drawings, in which Figure 1 is a view, partly diagrammatic, of the preferred form of the apparatus; and Fig. 2, a similar view of a modified form of the same.

1 2 are the conductors of the main circuit, having a continuous high-tension current supplied by one or more dynamo or magneto electric machines, while 3 4 are the main conductors of the house or consumption circuit, requiring a continuous current of lower tension, and provided with lamps, motors, or other translating devices, A, located in multiple-arc circuits and independently controllable. B, C, D, and E, are pairs of magnetic cores having fine-wire or high-resistance coils *a* and coarse-wire or low-resistance coils *b*. These coils are connected together in two closed circuits connected at points between the pairs of magnetic cores with the bars of separate commutator-cylinders F G. Two sets of commutator-brushes, *c d* and *e f*, are mounted upon a common shaft, H, and revolved together. The brushes *c d* are in a multiple-arc circuit from the conductors 1 2 of the main circuit, while the brushes *e f* are connected with the conductors 3 4 of the consumption-circuit. The shaft H may be revolved by an electromotor or in any other suitable way, as by a spring or weight actuated mechanism.

It will be understood that each house-circuit will be connected with the main circuit through induction apparatus, all the connections being independent multiple-arc connections.

Instead of the separate pairs of magnetic cores, a single annular core, I, can be used. (Shown in dotted lines in Fig. 2.) This core is wound with two sets of wire coils, each being continuous, like the winding of a Gramme ring, one set of high resistance (shown in dotted lines) connected with bars of commutator-cylinder F, the brushes or springs on which are connected with the conductors 1 2 of the main circuit, and the other set of low resistance (shown in full lines) connected with the bars of commutator-cylinder G, the brushes or springs on which are connected with the consumption-circuit 3 4.

The double-wound ring I and the commutator-cylinders F G may be revolved, or they may be held stationary and the commutator-brushes be revolved. An iron ring, K, is preferably placed outside of the double-wound ring I, to carry the magnetism between the ends of the neutral line.

In my Patent No. 265,786, dated October 10, 1882, is shown a series of combined motors and generators, the motors being placed in the main circuit and the generator-coils supplying translation-circuits with currents of reduced tension. Therefore I do not herein claim a system of this character.

What I claim is—

1. The combination, with a main circuit having a continuous current of high tension, of a consumption-circuit of low tension, provided with translating devices arranged in multiple arc, and an intermediate induction apparatus for reducing the tension of the current, substantially as set forth.

2. The combination, with a main circuit having a continuous current of high tension, of a consumption-circuit, an intermediate double-wound magnetic core or cores, and commutators for simultaneously changing or advancing the connections of the circuits with the windings of such core or cores, substantially as set forth.

3. The combination, with the main and consumption circuits, of a magnetic core or cores, provided with two sets of coils, one of high and one of low resistance, connected in separate closed circuits, and two commutators, one connecting the high-resistance coils at intervals with the main circuit and one connecting the low-resistance coils at intervals with the consumption-circuit, the connections of the main and consumption circuits being changed or advanced simultaneously, substantially as set forth.

4. The combination, with the main and consumption circuits, of the double-wound stationary core or cores, the stationary commutator-cylinders connected at intervals with the windings of such core or cores, and the simultaneously-revolving commutator brushes or springs connected with the main and consumption circuits, substantially as set forth.

5. The combination, with the main and consumption circuits, of the double-wound core or cores, the commutator-cylinders, and the exterior iron ring, substantially as set forth.

This specification signed and witnessed this 7th day of July, 1882.

THOMAS A. EDISON.

Witnesses:

RICHD. N. DYER,

EDWARD H. PYATT.

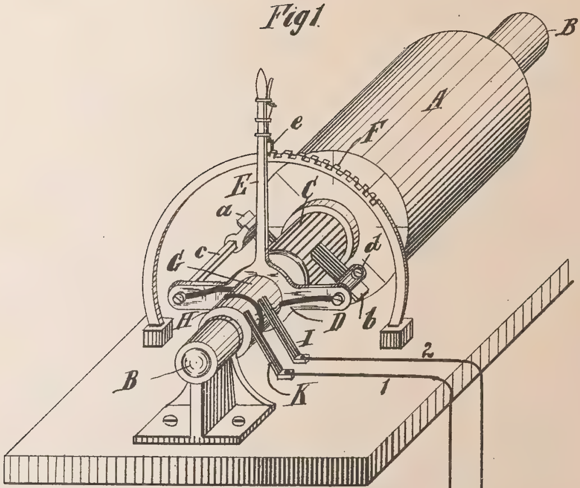
(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 278,419. Patented May 29, 1883.

Fig 1.



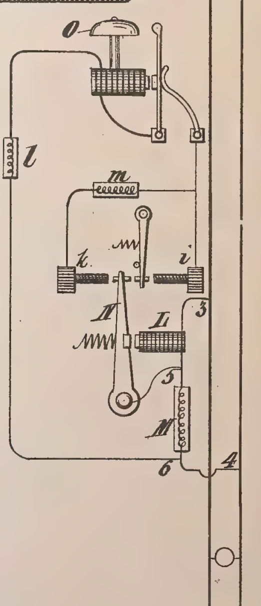
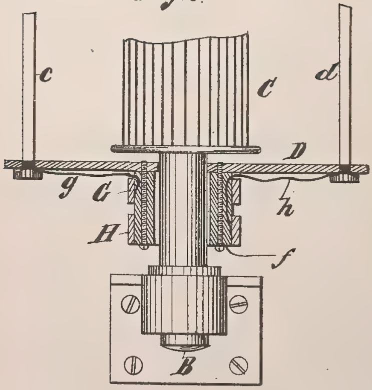


Fig 2.



WITNESSES:

Thomas E. Birch.

O. D. Mott

INVENTOR:

T. A. Edison

BY Rich^d. N. Dyer,

ATTORNEY

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 278,419, dated May 29, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines, (Case No. 388;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce simple and efficient means for regulating the generative capacity of dynamo or magneto electric machines, which means will not require in their operation and adjustment the attention of a person skilled in the working of electrical apparatus. This I accomplish by constructing and arranging the commutator-brushes so that they can be readily shifted to and can be conveniently and securely held in any desired position between the point of greatest generation and that of no generation, and by providing at the machine an indicator or alarm which will show in a simple manner the condition of the current and will serve as a guide in the adjustment of the commutator-brushes.

In carrying out my invention the commutator-brushes are mounted upon arms projecting from a pivoted yoke which surrounds the armature-shaft and turns upon the axis of rotation, such arms being insulated from the yoke and being connected electrically with the main conductors leading from the machine. From the yoke projects a hand-lever having a spring locking device which engages with a toothed quadrant. This quadrant permits the adjustment of the brushes to any desired extent, and the locking device serves to hold the lever wherever it is placed.

In a multiple-arc or derived circuit from the main conductors is placed means for indicating electrically the strength of the current, which varies directly as does the candle-power of the lamps. The device I prefer to use is that shown in a prior application filed by me, (Serial No. 45,668,) by which an alarm is sounded when a certain strength of current corresponding with a definite candle-power is exceeded, and another alarm is given when the strength of the current in each multiple-arc circuit drops below a fixed limit; but a dynamometer may be used, or other form of indicator, for showing the strength of the current, with or without an alarm for calling attention to an abnormal condition of the current. The operator will shift the brushes in the direction indicated by the nature of the alarm or by the indicator until the alarm stops sounding, which will be when the current in the main conductors is restored to its normal condition. If, after the brushes are shifted to the position of greatest generation in increasing the strength of current, the alarm continues to sound, this will show that the number of translating devices should be reduced in order to restore the current to its normal strength.

The commutator-brushes may be connected with the main conductors by coiled wires connected with the arms that carry them, since the movement of the yoke in practice is not very great; but I prefer, on account of the large size that it is desirable to give these conductors, to make a swiveled connection between them and the commutator-brushes, so that the yoke can be readily moved to any desired extent without disturbing said conductors. This swiveling device is composed of two metal rings, which surround the shaft outside of the yoke and are supported upon insulation carried by said yoke. These insulated rings turn with the yoke and are connected electrically each with one of the commutator-brush-carrying arms. Two springs of plates, strips, or wires bear on these rings and are connected with the main conductors, allowing the yoke to be shifted in either direction to any extent.

The field-magnet of the generator, provided with the means described, is preferably energized by a constant source of electrical energy, such as a galvanic battery or another generator. The field-circuit may, however, be adapted to have the current passing through it varied in strength, and such circuit may be supplied from an external source, or from the machine itself.

The foregoing will be better understood by reference to the drawings, in which Figure 1 is a perspective view of a portion of a dynamo or magneto electric machine embodying a part of my invention, and a diagram of the means for indicating predetermined limits above and

below the normal condition of current; and Fig. 2, a top view and part horizontal section of the commutator end of the machine.

A is the armature of the machine, and B its shaft. The field-magnet is not shown. C is the commutator-cylinder, and *a b* the brushes bearing thereon. D is the pivoted yoke, having arms *c d*, which carry the commutator-brushes. E is the lever projecting from yoke. F is the toothed quadrant with which the lever is locked by means of spring locking device *e*. G H are the metal rings of the swiveling device, supported on hollow wood cylinder *f*, secured to the yoke. The arms *c d* are connected with rings G H by insulated arms *g h*. I K are the springs bearing on rings G H and connected with main conductors 1 2. In a multiple-arc circuit, 3 4, from the main conductors 1 2 are placed an electro-magnet, L, and a resistance, M. A shunt-circuit, 5 6, around the resistance M passes through armature-lever N in one direction, and in the other direction through a vibrating bell, O, after which the circuit is divided, and its two parts are connected with the front and back contacts, *i k*, of the armature-lever. Resistances *l m* are placed in shunt-circuit 5 6 to change the nature of the alarm, according to whether the lever makes the front or back contact, the sound of the bell being loud in one case and feeble in the other.

What I claim is—

1. A dynamo or magneto electric machine having movable commutator-brushes, and means operated by hand for adjusting and securing said commutator-brushes, in combination with means for indicating predetermined limits above and below the normal condition of the current, substantially as set forth.

2. The combination of the commutator-brushes carried by a pivoted yoke, a hand-lever and locking device for adjusting and holding said yoke, and means for indicating predetermined limits above and below the normal condition of the current, substantially as set forth.

3. In a dynamo or magneto electric machine, the movable commutator-brushes, in combination with swiveled connections between the same and the main conductors, substantially as set forth.

This specification signed and witnessed this 15th day of December, 1881.

THOMAS A. EDISON.

Witnesses:

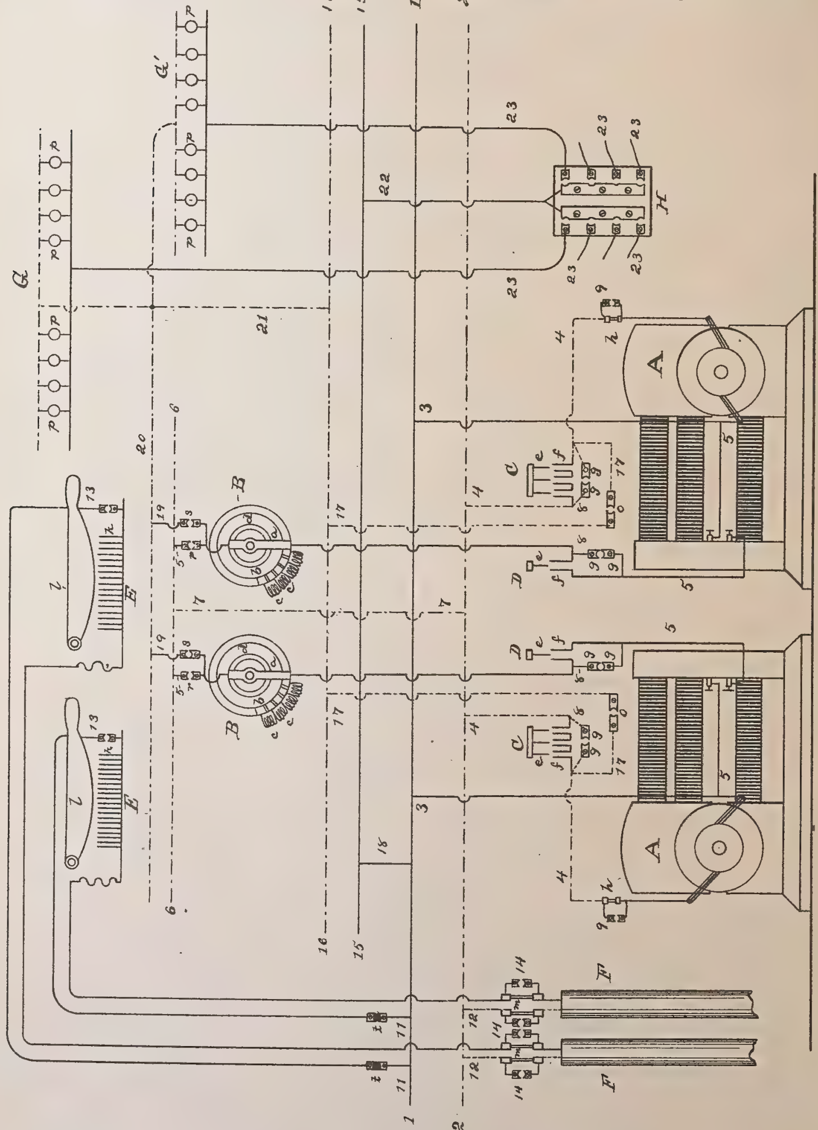
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 280,727. Patented July 3, 1883.



ATTEST:

E. C. Rowland

Henry W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,

Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 280,727, dated July 3, 1883.

Application filed March 16, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electrical Distribution, (Case No. 544,) of which the following is a specification.

In my system of electrical distribution I employ at a central station several dynamo-electric machines for generating current, which is then conveyed by feeding-conductors to the curcuits which contain the translating devices of the district.

My invention relates to the arrangement of the various devices and apparatus at such central stations, having for its object, principally, the maintaining of a constant electromotive force throughout the system, and also to promote the general efficiency and economy of the system.

In carrying out my invention I connect the two or more generators employed in multiple arc from the same main conductors, each armature and each field-magnet being in its own separate multiple-arc circuit. In connection with each machine I preferably employ a single circuit-controller of such form that it will break both the field and the armature circuit by the same movement, and the latter somewhat in advance of the former, for if the field-circuit were broken before the armature-circuit, the main conductors would be short-circuited and the armature burned out. Separate circuit-controllers might, however, be employed, care being taken to always break the armature-circuit before the field. In each field-circuit is placed an adjustable resistance of suitable construction. The feeding-conductors, which convey the current to the incandescent electric lamps or other translating devices of the system, are connected in multiple arc to the main conductors. Each feeding-circuit contains an adjustable resistance, and may be provided with a suitable circuit-controller. Within the station are provided, also, a large number of electric lamps, which are thrown into circuit whenever an additional generator is connected to the main conductors to compensate for such addition in the translating devices without the station, in order to prevent such a sudden accession of current in the district as cannot be readily compensated for by the field-resistances. This is accomplished as follows: When the generator is to be connected, instead of connecting its armature at once to the main conductors, it is connected with other conductors, from which multiple-arc connections are made to the lamps within the station, which are commonly termed "testing-lamps." These lamps are divided into groups, and a switch-board is provided by which more or less of these groups may be placed in circuit. As many lamps are first included as are being supplied in the district by each of the machines already in circuit. The armature-circuit to the main conductors is then also closed, which makes the testing-lamps a part of the circuit supplied by all the generators. The throwing in of the additional generator, therefore, produces no material effect on the current in the translating devices without the station, and any slight change in electro-motive force is compensated for by adjusting the field-circuit resistance. The testing-lamps are then gradually plugged out at the switch-board, the regulating-resistances being constantly adjusted to maintain a constant electro-motive force. The testing-lamps can, however, be used also for testing the efficiency of the generators. To accomplish this the field and armature circuits of each generator can be disconnected from the main conductors of the system and connected to the main testing-circuit. By means of the switch-board a greater or less number of the testing-lamps may be placed in circuit. The armature-circuit of each machine contains a safety-catch of the proper size to prevent injury to the armature. Each feeding-conductor also contains such a safety-catch, and around each safety-catch is a shunt, which may be closed by the insertion of a plug, if the safety-catch is destroyed, to maintain circuit while such safety-catch is replaced. Around each armature and field-circuit controller is placed a similar shunt, which is closed by a plug after the circuit is closed, to prevent heating at the contacts of the circuit-controller.

My invention is illustrated in the accompa-

nying drawing, which is a diagram of the circuits and apparatus at a central station.

A A are dynamo-electric machines. Preferably each of said machines is driven by a steam-engine, the armature being revolved directly by the shaft of the engine without the use of belts or other gearing, and the engine and generator being both mounted on the same bed-plate. From the commutator-brushes of each machine a circuit, 3 4, leads, which is connected to the main conductors 1 2. A conductor, 5, connected to armature-circuit conductor 3, includes the field-magnet coils of the machine, and thence extends to the adjustable resistance B. This resistance is preferably of the form shown in my application No. 540, (Serial No. 82,565.) The end of arm *a* rests on a circle of contact-plates, *b*, (only a portion of which are shown,) which are connected to resistance-coils *c c*, and the revolution of said arm throws such coils in or out of circuit. Such arm bears constantly on a metal ring, *d*, from which the conductor 5 runs to a conductor, 6. A single conductor, 7, runs from wire 6 to main conductor 2, forming a common return for the field-circuits of both or all the generators.

Preferably means are provided whereby all the resistances B may be simultaneously adjusted, as set forth in my application last referred to. The resistances are to regulate the electro-motive force of the machines according to the whole number of translating devices in circuit in the system.

In each armature-circuit is placed a circuit-controller, C, and in each field-circuit a circuit-controller, D, the circuits being opened and closed by the withdrawal or entrance of contacts *e* between contacts *f*. Preferably the circuit-controllers C and D of a machine are operated by the same movement, circuit being broken somewhat sooner and closed somewhat later at C than at D, the moving contacts of both being attached to the same pivoted arm, as set forth in my application No. 543, (Serial No. 88,355.) Around each circuit-controller is a shunt, 8, broken at contacts *g g*. These shunts are to be closed by the insertion of guard-plugs when the circuits are closed at C D, to prevent heating of the latter contacts. Each armature-circuit contains, also, a safety-catch, *h*, to prevent injury to the armature by an excessive reduction of resistance of the external circuit, and around each safety-catch is a guard-plug shunt, 9, by which the circuit may be completed while the safety-catch is replaced.

To the main conductors 1 2 are connected feeding-conductors 11 12, by which current is conveyed to the different parts of the district supplied from the station. A conductor, 11, of each feeding-circuit includes an adjustable resistance, E. This resistance is preferably like that shown in the joint application of Charles L. Clarke and myself, (Serial No. 74,778.) The conductor 11 is broken, and the two parts lie parallel with each other. On one side are attached a number of carbon rods *k*, and the metal blade *l* is in sliding contact with the other side. When such blade is pressed down, it places more or less of the carbon rods in multiple arc across the break, and so decreases or increases the resistance of the circuit. These resistances are to regulate the current in the feeders for variations in the number of translating devices in the part of the district contiguous to the terminals of each feeder. A guard-plug shunt, 13, is formed around each resistance, so that circuit may be completed if it is desired to dispense with such resistances. Each feeding-circuit is provided with a plug, *t*, for opening and closing the circuit. This, however, may be dispensed with, and the circuits made and broken by inserting and removing the safety-catches and guard-plugs. Each feeding-circuit leaves the station inclosed in a tube, F. In each feeding-conductor is a safety-catch, *m*, and around each safety-catch is a guard-plug shunt, 14, for the purpose above explained.

The testing-lamps are represented by *p p*. 15 16 are the main testing-conductors. To connect the armature of a generator to this circuit, the circuit-controller C and shunt 8 are opened, and shunt 17 is closed by inserting a plug at *o*. This connects conductor 4 to 16, instead of to 2, and, as conductor 15 is already connected to conductor 1 by conductor 18, the armature-circuit is thus connected to the main testing-circuit. To connect the field of a generator, conductor 5 is broken at *r* and conductor 19 closed at *s*, making connection to conductor 20, from which conductor 21 runs to main testing-conductor 16. The lamps *p* are divided into groups, each of a suitable number. Two of such groups, G and G′, are shown. From conductor 15 a wire, 22, runs to a switch-board, H, and from the opposite terminals of the switch-board wires 23 run, one to a conductor of each group of lamps. The opposite conductor of each group is connected through conductor 21 to conductor 16. Each group of lamps is connected in circuit by the insertion of a plug between the proper terminals of the switch-board. Thus any desired load may be put upon a generator, whereby its capacity and efficiency may be tested. The main object of the testing-lamps—that is, to compensate in the translating devices of the system without the station when an additional generator is placed in circuit to prevent a sudden increase in electro-motive force by such addition—is, however, accomplished as follows: When such an increase of lamps is expected in the district as will require the addition of a generator to those already in circuit, as many groups of lamps *p* are connected by means of the switch-board H to the main testing-circuit 15 16 as are supplied by each of the already connected generators. The field-circuit of the generator is closed by the insertion of a plug in the shunt 8 around the circuit-controller D, the plugs being also in-

serted at *r* and *s*. The shunt 17 is then closed at *o*, which connects the generator with all the testing-lamps connected at the switch-board. The circuit-controller C is then closed, which connects both the lamps and the generator to the main circuit. The proportion of generators and lamps throughout the entire system thus remains the same or nearly the same, any slight difference being adjusted by regulating the resistances B B. The groups G of testing-lamps are then cut out of circuit at the switch-board, one after another, and the field-resistances are adjusted so that a constant electro-motive force is maintained.

By the use of the regulating means described—first, means situated within the station for compensating in the translating devices without the station for the addition of a generator to the main circuit; second, the adjustable resistances in the field-circuits for adjusting the gradual variations which occur in the total number of lamps in circuit; and, third, the adjustable resistances in the feeding-circuits, forming regulators for variations at the different centers of consumption—I am enabled to maintain a practically-constant electro-motive force throughout the system under all circumstances, and, in addition, I may, if desired, regulate the entire system by the connection and disconnection of feeders.

It is to be understood that all patentable features of invention described or shown, but not claimed herein, are reserved for protection by other patents, and have been or will be embraced in other applications for patents.

What I claim is—

1. In a system of electrical distribution, means situated within the central station for compensating in the translating devices without the station for the increased electro-motive force caused by the addition of a generator to those already in circuit, substantially as set forth.

2. In a system of electrical distribution, the combination of two or more generators, the main circuit, means for separately connecting said generators thereto, the circuit containing the testing or compensating lamps, and means for separately connecting the generators to said circuit, substantially as set forth.

3. In a system of electrical distribution, the combination of the two or more generators, the main circuit, means for separately connecting said generators to said main circuit, the circuit containing the testing or compensating lamps, means for separately connecting the generators thereto, and means for connecting the main circuit with the testing or compensating lamp-circuit, substantially as set forth.

4. In a system of electrical distribution, the combination of the two or more generators, each having its field and its armature in a separate multiple-arc circuit from the main conductors, of means for disconnecting the armature-circuit alone or both the field and armature from said main conductors and connecting them instead to a circuit containing testing or compensating lamps, substantially as set forth.

5. The testing or compensating lamps arranged in groups, in combination with means for placing more or less of such groups in connection with the generators, substantially as set forth.

6. The combination, with the testing or compensating lamps arranged to be gradually thrown out of circuit, of the adjustable resistances in the field-circuits of the generators, for compensating for the variations in electro-motive force, substantially as set forth.

7. In a system of electrical distribution, the combination of the testing or compensating lamps, the adjustable resistances in the field-circuits of the generators, and the adjustable resistances in the feeding-circuits, whereby a constant electro-motive force is maintained throughout the system, substantially as set forth.

8. In a system of electrical distribution, the combination of the adjustable resistances in the field-circuits of the generators, and the adjustable resistances in the feeding-circuits, substantially as set forth.

9. The method of maintaining a constant electro-motive force in a system of electrical distribution employing two or more generators when an additional generator is placed in circuit, consisting in first connecting said generator with a number of lamps not connected with the rest of the system, and then connecting it also with the main circuit of the system, whereby the proportion of lamps and generators remains the same, substantially as set forth.

10. The method of maintaining a constant electro-motive force in a system of electrical distribution employing two or more generators when an additional generator is placed in circuit, consisting in first connecting said generator with a number of lamps not connected with the rest of the system, then connecting it also with the main circuit of the system, and then gradually removing said lamps, at the same time regulating the adjustable resistances in the field-circuits of the generators, substantially as set forth.

This specification signed and witnessed this 13th day of February, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

EDWARD H. PYATT.

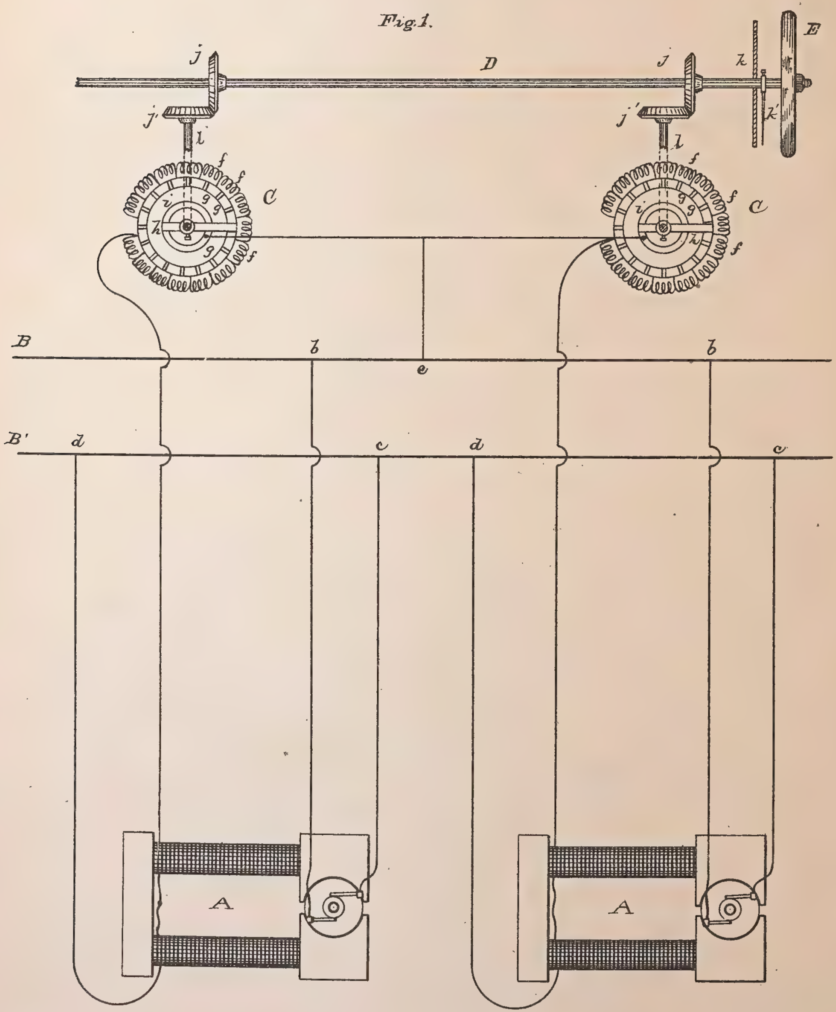
(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 281,349. Patented July 17, 1883.

Fig. 1.



ATTEST:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison
By Rich^d N. Dyer.
Att'y

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 281,349. Patented July 17, 1883.

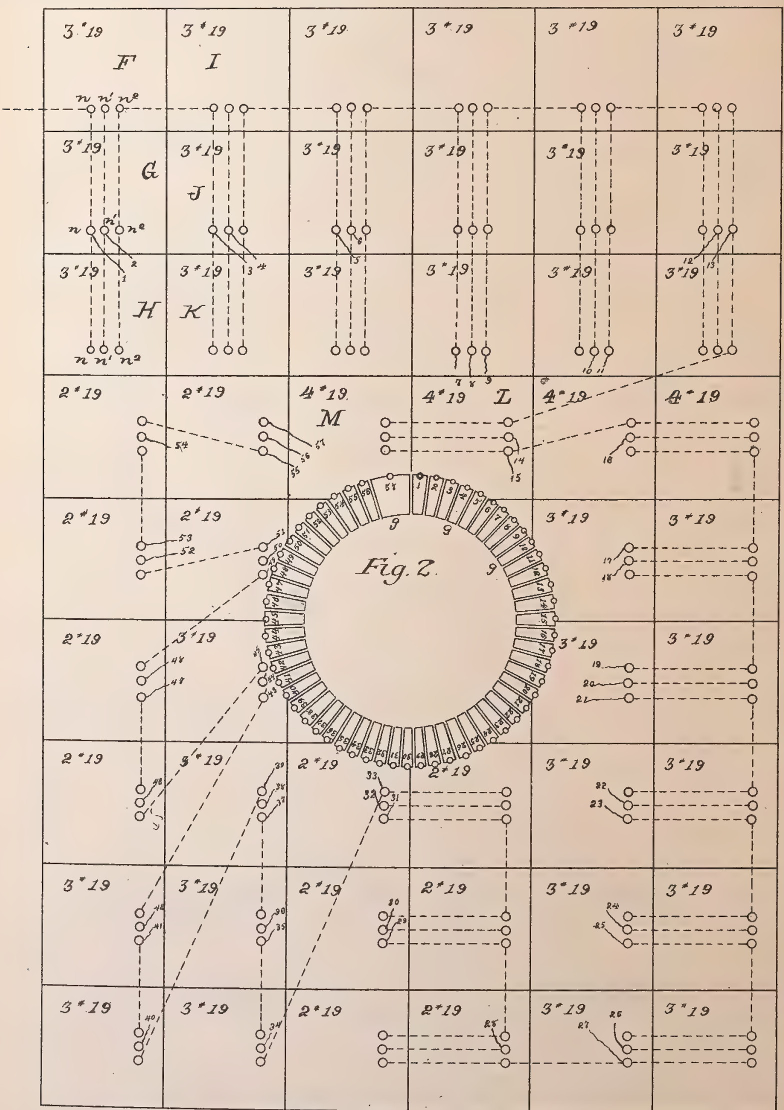


Fig. 2.

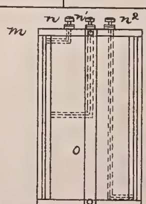


Fig. 3.

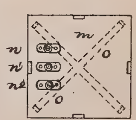


Fig. 4

ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Richd. N. Dyer.

Atty.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 281,349, dated July 17, 1883.

Application filed January 22, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulating Electric Generators, (Case No. 540,) of which the following is a specification.

My invention relates to the regulation of dynamo or magneto electric generators when a number of such generators are placed at a central station to supply current to the translating devices of a system. Each of such generators has its field-magnet coils in a circuit independent of the field-circuits of the other generators, and in each field-circuit is placed an adjustable resistance to regulate the generation of current according to the number of translating devices in circuit in the district supplied; and a portion of my invention consists in providing means whereby all such resistances may be adjusted simultaneously and to the same extent, it being necessary to do this because all such generators feed into the same circuit or system of circuits, so that all should have the same electro-motive force.

The object of the second part of my invention is to provide adjustable resistances for use in the field-circuits of the generators, which can be adjusted gradually and in the proper proportion, and shall be so formed that the conducting area of the resistance-coils shall be proportioned to the amount of current flowing in the circuit—that is, when but little resistance is placed in the circuit and a comparatively large current is passing the conducting area of the resistance thrown in will be correspondingly large, and as more resistances are thrown in and the current decreases the conducting area of such resistances will decrease correspondingly. By this means the heating of the coils is prevented, as there is always sufficient area to convey the current which passes. I accomplish this by providing a number of resistance-boxes of gradually-diminishing conducting capacity and means for successively throwing them into circuit. Such boxes preferably consist each of an insulating-frame upon which are wound wire coils. Each box is provided with three binding-posts, and the coils on said box are separately connected to all of said binding-posts, so that such coils are divided into two parts in multiple-arc relation to each other. Suitable connections are made between the boxes, as will be explained. A commutator is provided having an adjusting-arm connected in the circuit, and from each commutator-plate a wire runs to one of the binding-posts of a resistance-box. Preferably, to connect the adjusting arm in the circuit, a ring is provided, upon which said arm bears in its revolution, a wire of the circuit being connected to said ring. The connections between the boxes and from the boxes to the commutator-plates are so made that when it is first commenced to throw resistance into the circuit several coils in multiple arc will be thrown in, so that sufficient current-carrying area is provided. As more coils are thrown in the number in multiple arc with each other is lessened, until finally coils are thrown in in series one after another. To allow a still further graduation, some of the boxes are wound with two, some with three, and some with four strands of wire, and the different kinds are arranged so that they will be thrown in at the proper times.

The above will be better understood by reference to the drawings, in which Figure 1 is a view mostly in diagram, representing the resistances in the field-circuits of two generators and means for regulating them simultaneously; Fig. 2, a diagram illustrating the resistance-connections; Fig. 3, an elevation of one of the resistance-boxes, with part of the coils in dotted lines; and Fig. 4, a top view of the same.

Referring to Fig. 1, A A represent dynamo-electric machines having their armatures in multiple-arc circuits *b c* from the main circuit B B′. The field-magnets of the machines are each connected in a multiple-arc circuit, *d e*, from said main circuit. Each field-circuit contains an adjustable resistance, C, consisting of wire coils *f f*, connected to commutator-plates *g g*. A pivoted arm, *h*, makes contact with the plates *g*, and is also constantly in contact with a metal ring, *i*, which ring is connected in the circuit, a flat spring being preferably attached to the under side of said arm to in-

sure good contact. The movement of the arm h thus varies the resistance of the circuit. Each arm h is placed on a shaft, l, which, for convenience, is shown in dotted lines, and both shafts l are turned by means of bevel-gears j j', the gears j being on a shaft, D, which is turned by a hand-wheel, E. A dial, k, is provided, and a pointer, k', is placed on the shaft D, whereby the amount of resistance in circuit is indicated. The turning of the hand-wheel E varies the resistance of the field-circuits of both generators.

The resistance-boxes used are preferably of the form shown in Figs. 3 and 4, consisting of a wooden top, m, provided with three binding-posts, n n' n^2, surrounding a frame, o o, (shown in dotted lines in Fig. 4,) the edges of each frame having grooves in which the coils are wound. Such coils are wound around the entire frame, and are connected to all the binding-posts, there being thus two sections of coils in multiple-arc relation to each other.

The wire used is preferably copper wire No. 19, B. W. G., and two, three, or four strands twisted together are used on the different boxes.

Fig. 2 illustrates the preferred arrangement of the boxes. The commutator-plates g g are numbered, respectively, from 1 to 57. Wires p from binding-posts n n' n^2 extend to such plates, the connections to the plates being, for convenience, shown by placing the numbers at the ends of said wires. The dotted lines indicate the connections from box to box, the connections within the respective boxes not being shown, they being made as previously explained. When the adjusting-arm rests on plate No. 1, which is connected with binding-post n of box G, it is evident that no resistance is in circuit, the current passing directly from binding-post n of box F to that of box G; but on swinging the adjusting-arm to plate No. 2, which, as indicated, is connected with post n' of box G, the current will pass through half the coils of each of the boxes F G H, such halves being in multiple arc to each other. Thus while resistance is placed in circuit sufficient conducting area is provided for the large amount of current which so small a resistance allows to pass. The boxes mentioned are each wound with three strands of No. 19 wire, as indicated. When plate No. 3 is connected, all the coils of boxes F G H are in circuit in multiple arc to each other. No. 4 adds half of each of the boxes I, J, and K, and this continues, half of each set of three boxes being thrown in with each successive commutator-plate until plate No. 14 is reached. The passage from plate No. 13 to No. 14 throws in in multiple arc to each other half of each of the two boxes L and M, this being done because the current has now decreased so far that the current-carrying capacity may be diminished. In order, however, that the change may be made gradual, the boxes L and M are wound, as indicated, with four instead of three strands of No. 19 wire. Beginning with plate No. 18, halves of two boxes of three strands are used, this continuing as far as plate No. 27. From plate No. 28 to No. 33, inclusive, halves of two boxes of two strands each are used. With plate No. 34 half a box of three strands is thrown in in series, and this continues to plate No. 45. With 46 to 57 half-boxes of two strands each are thrown in in series.

I do not confine myself, of course, to the particular number of plates or of boxes and coils shown, or to the especial arrangement and connections of such plates and coils. I have, however, shown an efficient arrangement for accomplishing my object—that is, to so construct an adjustable resistance that the resistances first thrown into circuit will be of comparatively great conducting capacity, while those afterward thrown in gradually decrease in this respect.

What I claim is—

1. The combination of two or more dynamo or magneto electric machines, each having its independent field-circuit, with an adjustable resistance in each of said field-circuits, and means for adjusting all of said resistances simultaneously, substantially as set forth.

2. The combination of two or more dynamo or magneto electric machines, a resistance in the field-circuit of each machine, an arm for adjusting each resistance, and means for moving all such arms simultaneously, substantially as set forth.

3. A rheostat composed of a series of resistance-boxes connected together in multiple arc and series, as described and shown, in combination with commutator-plates to which such boxes are connected, and an adjusting-arm, substantially as set forth.

This specification signed and witnessed this 13th day of January, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

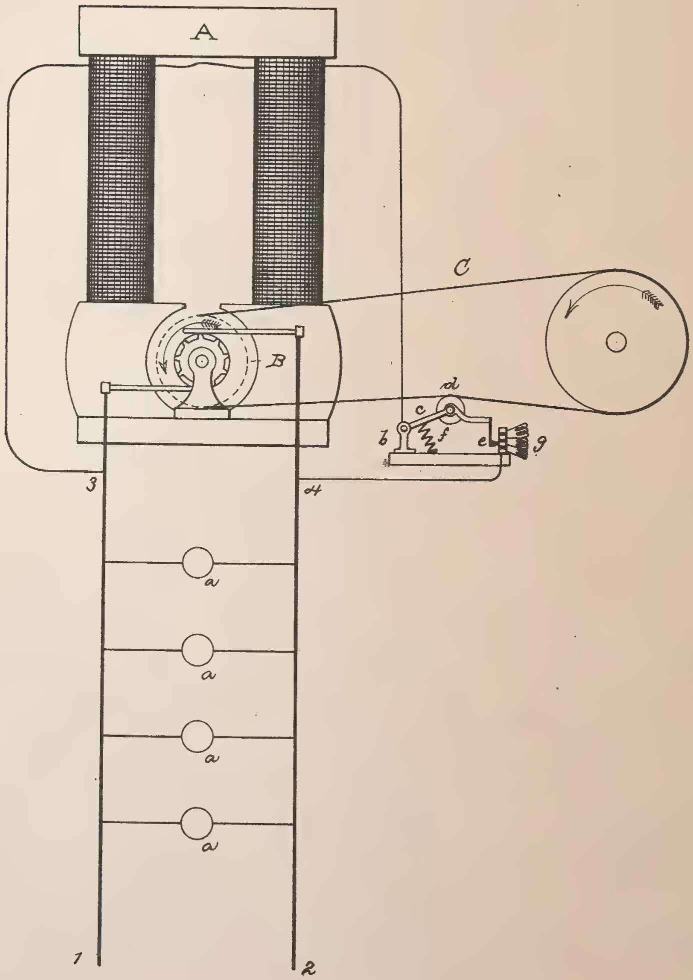
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 281,350. Patented July 17, 1883.



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E. C. Rowland
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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 281,350, dated July 17, 1883.

Application filed November 23, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulators for Dynamo-Electric Machines, (Case No. 519,) of which the following is a specification.

The object of my invention is to produce simple and efficient means for automatically varying the current generated by a dynamo or magneto electric machine supplying translating devices arranged in multiple arc, according to variations in the number of such translating devices in circuit from the machine.

Heretofore various electrical devices have been employed whose variations of energy, occasioned by changes in the current flowing, due to variations in the number of translating devices, have caused the adjustment of resistances for regulating the generation of current. By my present invention I do away with such electrical apparatus, said invention consisting in causing the variations in the number of translating devices to set in operation mechanical means whose operation causes the proper regulation. Preferably such mechanical means operate to vary the resistance in the field-circuit of the machine.

My invention may be accomplished as follows: The armature is revolved by a belt from suitable motive power. Upon the tight or driving side of the belt bears a wheel or roller carried by an arm and pressed closely against the belt by a powerful spring. One end of this arm makes contact with the contact-points of an adjustable resistance in the field-circuit of the machine, the arm being also included in such field-circuit, which is preferably a multiple-arc circuit from the main conductors, though it may be a shunt from one of said main conductors, or a circuit supplied with current from an external source. As the number of translating devices in circuit, and consequently the load driven by the belt, increases, the driving side of the belt tightens, and, pressing on the wheel, compresses the spring and moves the arm, so as to throw resistance out of the field; and a decrease in the number of translating devices allows the belt to slacken, when the spring presses the arm in the opposite direction from before, so as to place resistance in the field, the generation of current being thus regulated according to the requirements of the system.

My invention is illustrated in the accompanying drawing, which is a partly diagrammatic view of a dynamo-electric machine, with the accompanying circuits and regulating apparatus.

A is the field-magnet, and B the armature, revolved by belt C, as indicated by the arrows. From the commutator-brushes of the machine extend main conductors 1 2 in multiple-arc circuits, from which are placed lamps, motors, or other translating devices, *a a*.

To any suitable support, *b*, is pivoted an arm, *c*, carrying a wheel, *d*, and a contact-point, *e*. A heavy spring, *f*, tends to press the wheel *d* closely against the belt C. The point *e* is arranged to make contact with the contacts of an adjustable resistance, *g*, placed in the multiple-arc circuit 3 4, which includes the field-magnet coils of the machine. As above explained, the tightening of the belt C, caused by an increase in the number of translating devices in circuit, presses down the arm *c* and cuts out a part of the resistance *g* from the field-circuit, while on a decrease in the number of lamps or motors the spring *f* presses the arm up and increases the resistance in the field.

What I claim is—

1. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of mechanical means operated directly by variations in the load or pull upon the armature for regulating the generation of current by the machine, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine, an adjustable resistance in the field-circuit thereof, and translating devices arranged in multiple arc, of mechanical means operated directly by variations in the load or pull upon the armature for varying said adjustable resistance, substantially as set forth.

3. The combination, with a dynamo or mag-

neto electric machine, the motor actuating the same, and the belt connecting said machine and said motor, of means actuated by variations in the tightness of such belt for regulating the generation of current by said machine, substantially as set forth.

4. The combination, with the belt connecting the generator with the motor which actuates it, of the arm carrying a wheel bearing on said belt, the spring holding said wheel against said belt, the contact-point carried by said arm, and the adjustable resistance in the field-circuit of the generator, substantially as set forth.

This specification signed and witnessed this 13th day of November, 1882.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

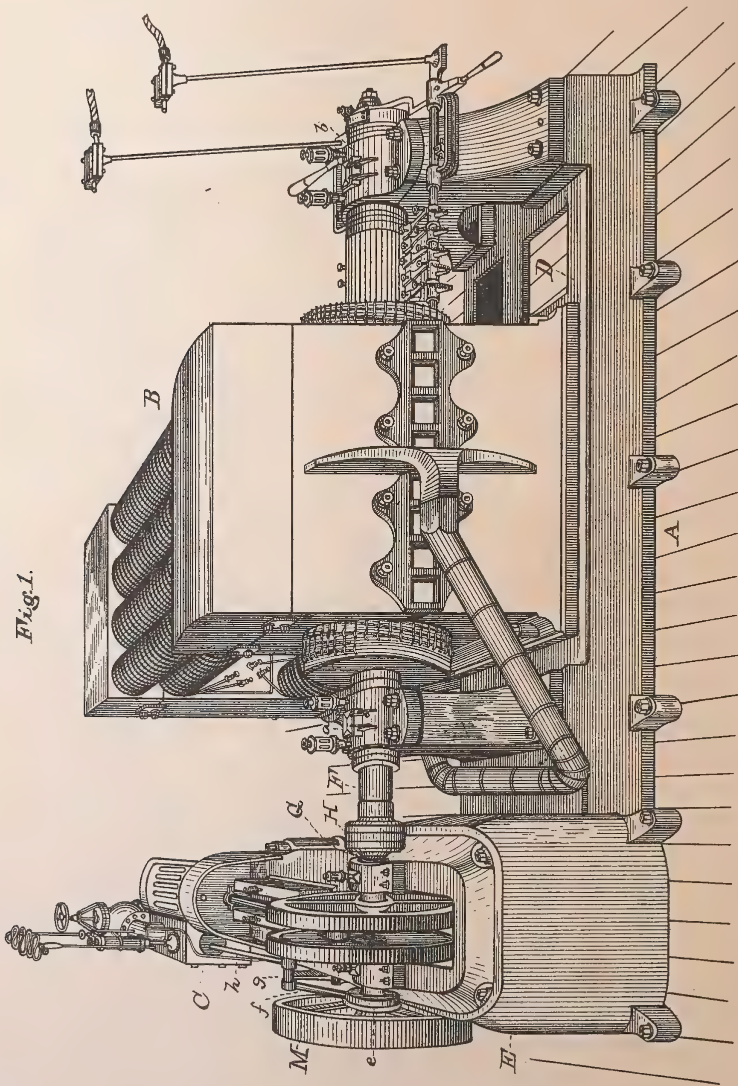
EDWARD H. PYATT.

(No Model.) 3 Sheets—Sheet 1.

T. A. EDISON.

ELECTRICAL GENERATOR.

No. 281,351. Patented July 17, 1883.



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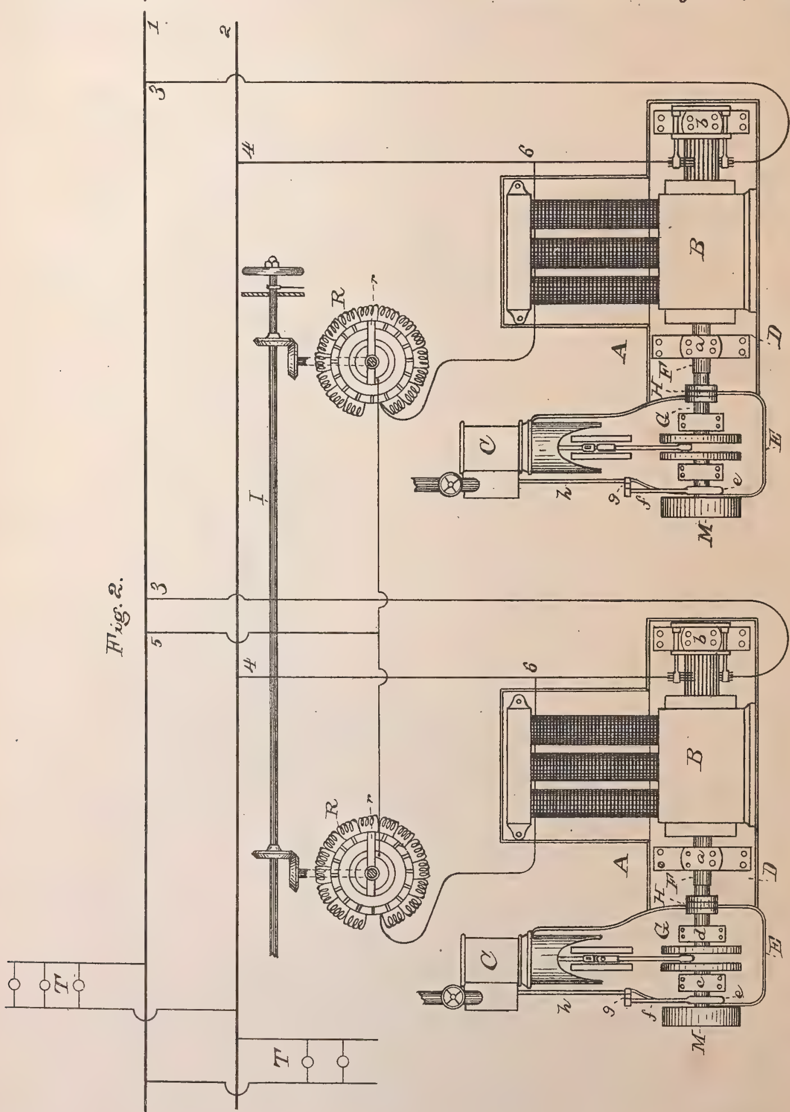
(No Model.) T. A. EDISON. 3 Sheets—Sheet 2.

ELECTRICAL GENERATOR.

No. 281,351. Patented July 17, 1883.



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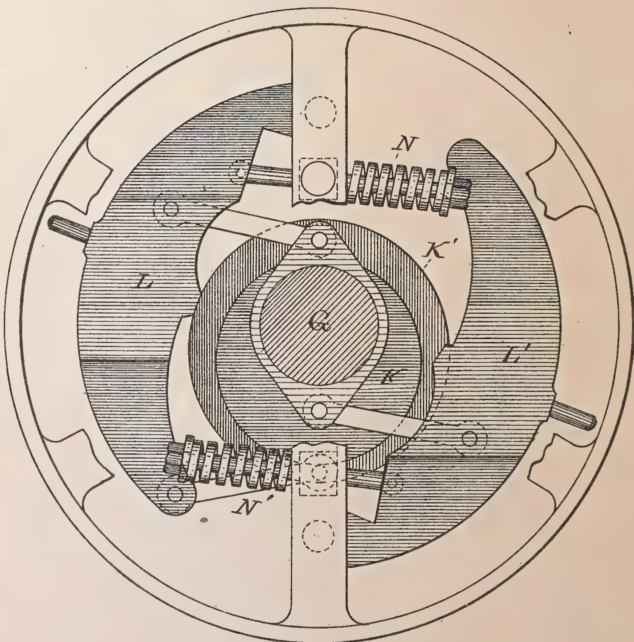
(No Model.) 3 Sheets—Sheet 3.

T. A. EDISON.

ELECTRICAL GENERATOR.

No. 281,351. Patented July 17, 1883.

Fig. 3.



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United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRICAL GENERATOR.

SPECIFICATION forming part of Letters Patent No. 281,351, dated July 17, 1883.

Application filed March 16, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Generators, (Case No. 552,) of which the following is a specification.

The object I have in view is an arrangement and construction of electrical generators and operating steam-engines suitable for use in a central-station plant for supplying electricity to conductors of a system of general distribution, wherein a continuous and constant pressure is maintained on the mains or in other locations where two or more generators are employed, feeding separately into the same circuit. For such a plant I provide separate and independent high-speed and high-pressure steam-engines for operating the dynamo or magneto electric machines, the advantages possessed by this construction over the use of a large low-speed and low-pressure engine for running all of the machines being of vital importance in a general system of electrical distribution. There is greater economy in running generators by separate high-speed engines, since the number of engines in operation can be changed as required by the work to be done or the number of translating devices in circuit. To get a certain speed with a large low-speed engine a definite boiler-pressure has to be maintained, no matter how small the load upon the engine may be; hence there is a great loss of power when the load is small, which loss increases largely as the load is decreased below the point of greatest economy. With the large low-speed engine, when the load is small, the friction becomes an important factor in the work of the engine, and the economy is greatly lessened. These difficulties are not met with when separate high-speed engines are used, since the engines can be thrown out of operation as the load decreases, and the engines left running be worked with good economy. The boilers (of which there would be a number, preferably the same number as the engines) can be thrown out of operation, and hence the boilers can also be worked in the most economical way. With the large low-speed engine an extra engine of equal power would have to be provided for operating the machines in case the first engine should break down or had to be stopped for repairs, cleaning, or for other purposes. This makes it necessary to have double the engine capacity required for running the machines, making the investment for engines larger than when separate engines are used, since with the separate engines I have found that one extra or spare engine in every six is sufficient, making the reserve capacity only one-sixth the entire capacity, and this proportion might be still further reduced. In addition, with the large engine, the breaking down of such engine would cause the total extinguishing of the lamps for a time until the reserve engine could be started; but with a number of separate engines, when one engine breaks down, the load is taken by the other engines, and the lamps are not extinguished, but only a momentary drop in the candle-power occurs, which is instantly corrected by the regulation of the generators in the manner hereinafter stated. The wear upon the separate engines is also less, since they will be thrown out of operation a much greater proportion of the time than the large engine. A most important commercial advantage is the large saving in the investment for real estate for a central-station plant, it being possible to place the separate engines with the small reserve power in much less space than is required by the two large engines, with the necessary shafting, belting, clutches, &c.

The dynamo or magneto electric machines and steam-engines are made of the same capacity, and each dynamo or magneto electric machine is mounted upon the same base or bed with a steam-engine. This base is preferably made of cast-iron formed in convenient sections bolted or otherwise suitably secured together to form a solid support for the combined machine. The engine and dynamo have their shafts placed in line with each other and connected directly together to form a shaft common to both the engine and dynamo. The dynamos may be of any desired size. I have found that dynamos capable of supplying economically about fifteen hundred (1500) sixteen (16) candle incandescing electric lamps are

well adapted for large central-station plants. By the use of the direct connection between the engine and dynamo great economy results, since no power is lost in intermediate shafting or from the pull or slip of belts. The use of clutches is avoided for connecting the dynamos with and disconnecting them from the shafting. There is no danger of stoppage from breaking of belts or from the breakage or disarrangement of other parts of the intermediate mechanism, as there would be with the low-speed engine and its shafting. The direct connection makes the combined machine simple and reliable and adds greatly to the compactness, which is a feature of great importance, in that less room is required for the plant and the investment in real estate diminished.

With the high-speed engines the movement is uniform and a steady current is produced. The movement is made more uniform by the inertia of the armature, which has considerable weight. For a high-speed engine I have found that one making three hundred and fifty (350) revolutions per minute is suitable for the purpose; but it is evident that the dynamo could be constructed to work at a different speed. I also prefer to use a high boiler-pressure. About one hundred and ten pounds (110 lbs.) is an economical pressure; but it is evident that a lower pressure could be employed. The high-speed steam-engines used by me are provided with automatically-variable cut-off mechanisms. Engines of this kind possess the general advantage over throttling-engines of greater economy in the use of steam, and the especial advantage, when used to operate dynamo or magneto electric machines connected with and feeding into the same circuit, of closer regulation and greater uniformity of speed. Throttling-engines are wholly unsuited for the purpose on account of the loss of power and on account of the want of uniformity in speed. It is necessary that the engines should not vary more than about three per cent. (3%) in speed, and within this the regulation of the engine must be performed. A greater variation would cause the dynamos to differ in electro-motive force to such an extent that those of lowest electro-motive force at any given time would be converted into electromotors and be run as such by the dynamos of greatest electromotive force. This relation would be reversed by the movement of the governors, and in this way the power would be partly used up in the plant itself, and there would be an overloading of part of the dynamos, accompanied by extra sparking at the commutators and overheating of the armatures.

The most effective governor for cut-off engines for my purpose I have found to be a spring-governor—that is, a governor in which centrifugally-acting weights are opposed by heavy springs. The springs overcome the inertia of the weights, and the governor responds almost instantly to the slightest variation in speed, making all the engines work practically in unison, so that the differences in electro-motive force of the dynamos are not sufficient to cause the unequal loading of the machines; but I do not wish to limit myself to engines with spring-governors, since the variable cut-off mechanisms may be worked by other forms of governor. I have also found that the spring-governor and ball-governor engines may be worked together, one spring-governor engine being capable of compensating for irregularities in two or three ball-governor engines, preventing the occurrence of the peculiar operation before described.

With the base common both to the steam-engine and the dynamo or magneto electric machine, the direct connection between the engine and armature shafts, and the automatically-variable cut-off, the combined machine becomes a self-contained electrical generator, controlled by and accommodating itself to the external load automatically and with economy, and suitable for use in a central-station plant. The automatically-variable cut-off engine and the dynamo have a combined action and react one upon the other. An increase in the number of lamps in circuit throws more work upon the dynamo, and this in turn causes the cut-off of the engine to act at a later point in the stroke, admitting more steam into the cylinder and increasing the power of the engine. A decrease in the number of lamps in circuit has the reverse effect upon the dynamo and engine.

In a central-station plant there is a mutual action and reaction of the dynamos and cut-off engines, which is caused by the fact that the dynamos are connected with and feed into the same circuit. Suppose, for illustration, the maximum capacity of each dynamo to be fifteen hundred lamps, and that there are four dynamos in connection with the circuit and supplying six thousand lamps. Now the load will be equally distributed among the combined dynamos and engines, fifteen hundred to each combined machine, and the cut-offs of all the engines will be acting at the same point. As the lamps are gradually reduced in number the cut-offs of all the engines will vary in unison, cutting off steam earlier in the stroke, until there are but forty-five hundred lamps in circuit, eleven hundred and twenty-five to each dynamo, or something less than that number. Then the connection of one dynamo with the circuit can be broken and its engine stopped. The entire load is then thrown upon the three dynamos, which react upon the cut-offs of their engines and cause them to change in unison the point of cut-off to meet the increase of load. If more lamps are taken off, the same operation takes place until the number of lamps is reduced to three thousand or somewhat under that number, when another machine is disconnected from the circuit. The reverse operation takes place when lamps are being added to the circuit.

When a machine breaks down and has to be

stopped, the other machines take the load, dividing it up among them and acting in unison until an additional machine is started, when another division of the work takes place.

The engines have to regulate in unison and quickly, in order to prevent the overloading of part of the dynamos, and this can only be accomplished by the use of the self-contained generators. The generators are preferably dynamo-electric machines having their field-magnets in separate multiple-arc circuits derived from the main circuit; but a separate exciter may be employed. The lamps or other translating devices are arranged in multiple arc, and a change in the number of such translating devices produces variations in the arrangement of resistances and in the electromotive force of the machine independent of the speed at which the machine is driven. To compensate for this variation in electro-motive force, another species of regulation has to be resorted to in addition to that furnished by the automatically-variable cut-offs of the engines. For this purpose the strength of the field-magnets is varied by varying in unison and to the same extent the current flowing through the field-circuits of the several machines. This may be accomplished by the use of an adjustable resistance in the field-circuit of each machine, all the resistance-adjusting arms being operated simultaneously by a common shaft.

In the drawings, Figure 1 is a perspective view of the self-contained electrical generator; Fig. 2, a top view, partly diagrammatic, showing two of such machines in connection with the same circuit; and Fig. 3, an elevation of the spring-governor cut-off mechanism.

A is a cast-iron base, preferably made in sections bolted together, and forming a support for the dynamo or magneto electric machine B and the high-speed cut-off engine C.

The dynamo or magneto electric machine is preferably constructed as described in my Patents Nos. 263,133, 263,140, 264,647, and 265,785. The field-magnet is arranged horizontally and supported upon a depressed portion, D, of the base, to which it is bolted, while the engine-frame is bolted to an elevated portion, E, of the base.

The armature-shaft F of the machine B is journaled in bearings at *a b* upon the depressed portion D of the base, while the engine-shaft G is journaled in bearings *c d* on the elevated portion E of the base. The shafts F G are brought into line with each other, and are coupled directly together at H by any suitable coupling, preferably one accommodating itself to any slight deviation in the alignment of the shafts.

The commutator-brushes of the several dynamos used in a central-station plant are connected with the same main circuit, 1 2, the armatures being in multiple-arc or derived circuits 3 4 from such main circuit. The field-circuit 5 6 of each machine is a multiple-arc circuit from 1 2. It contains a resistance, R, adjusted by an arm, *r*. The arms *r* of the several resistances are connected with and moved simultaneously by a common shaft, I.

The lamps or other translating devices T are arranged in multiple arc from 1 2 or from circuits derived therefrom.

As before stated, the steam-engines C have cut-off mechanisms, and these are automatically operated by governors.

I prefer to use a spring-governor. In Fig. 3 is shown a form of spring-governor cut-off which I find well suited to the purpose, although I do not wish to limit myself to any particular form of governor. The engine-shaft G is provided with a double eccentric, K K′, connected by links to weights L L′, which are pivoted to the arms of the wheel M, keyed to the shaft. The weights L L′ are opposed by heavy springs N N′. Around the outer eccentric K′ is the eccentric-strap *e*, which is connected by rod *f* with a rocking arm, *g*, which in turn is connected with the valve-rod *h*.

I do not claim herein the peculiar features of the self-contained machine, *per se*, independent of its connection with other machines, or independent of the nature and arrangement of the translating devices supplied by it, since the same will be made the subject of another application for patent; and it is to be understood that all other patentable features of invention described or shown but not claimed herein are reserved for protection by other patents, and have been or will be embraced in other applications for patents.

What I claim is—

1. The combination, with one circuit, of two or more dynamo or magneto electric machines connected with such circuit and feeding into the same, and two or more independent steam-engines operating such dynamo or magneto electric machines, substantially as set forth.

2. The combination, with one circuit, of two or more dynamo or magneto electric machines connected in multiple arc with such circuit, and two or more independent steam-engines operating said dynamo or magneto electric machines, substantially as set forth.

3. The combination, with one circuit, of two or more dynamo or magneto electric machines connected with such circuit and feeding into the same, and two or more independent steam-engines operating such dynamo or magneto electric machines and having automatically-variable cut-off mechanisms, substantially as set forth.

4. The combination, with one circuit, of two or more dynamo or magneto electric machines connected with such circuit and feeding into the same, and two or more independent steam-engines operating such dynamo or magneto electric machines, and having cut-off mechanisms varied automatically by spring-governors, substantially as set forth.

5. The combination, with one circuit, of two or more dynamo or magneto electric machines

connected in multiple arc with such circuit, two or more independent steam-engines operating said dynamo or magneto electric machines, and translating devices connected in multiple arc with such circuit, substantially as set forth.

6. The combination of a dynamo or magneto electric machine, a steam-engine with automatically-variable cut-off, the direct connection, and common base, with translating devices connected in multiple arc with said machine, substantially as set forth.

7. The combination of two or more self-contained electrical generators connected with and feeding into the same circuit, each of such self-contained electrical generators being composed, essentially, of the following parts, viz: a dynamo or magneto electric machine, a high-speed steam-engine having an automatically-variable cut-off, a direct connection between the shaft of said engine and that of said dynamo or magneto electric machine, and a supporting base or bed common both to said steam-engine and said dynamo or magneto electric machine, substantially as set forth.

8. The combination of two or more self-contained electrical generators connected with and feeding into the same circuit, each of such self-contained electrical generators being composed, essentially, of the following parts, viz: a dynamo or magneto electric machine, a high-speed steam-engine provided with a variable cut-off and a spring-governor varying such cut-off automatically, a direct connection between the shaft of said engine and that of said dynamo or magneto electric machine, and a supporting base or bed common both to said steam-engine and said dynamo or magneto electric machine, substantially as set forth.

9. The combination, with one circuit, of two or more dynamo or magneto electric machines connected with such circuit and feeding into the same, two or more independent steam-engines operating such dynamo or magneto electric machines, and means for varying the electro-motive force of the machines independent of the speed of the engines, substantially as set forth.

10. The combination, with one circuit, of two or more dynamo or magneto electric machines connected with such circuit and feeding into the same, two or more independent steam-engines operating such dynamo or magneto electric machines and having automatically-variable cut-offs, and means for varying the electro-motive force of all the machines simultaneously independent of the speed, substantially as set forth.

11. The combination of a dynamo or magneto electric machine, a steam-engine with automatically-variable cut-off, the direct connection, and common base, with means for varying the electro-motive force of the machine independent of the speed, substantially as set forth.

12. The combination, with one circuit, of two or more dynamo or magneto electric machines connected in multiple arc therewith, two or more independent steam-engines operating such dynamo or magneto electric machines, means for varying the electro-motive force of all the machines simultaneously independent of the speed, and translating devices connected in multiple arc with said circuit, substantially as set forth.

This specification signed and witnessed this 5th day of March, 1883.

THOS. A. EDISON.

Witnesses:

WM. H. MEADOWCROFT,

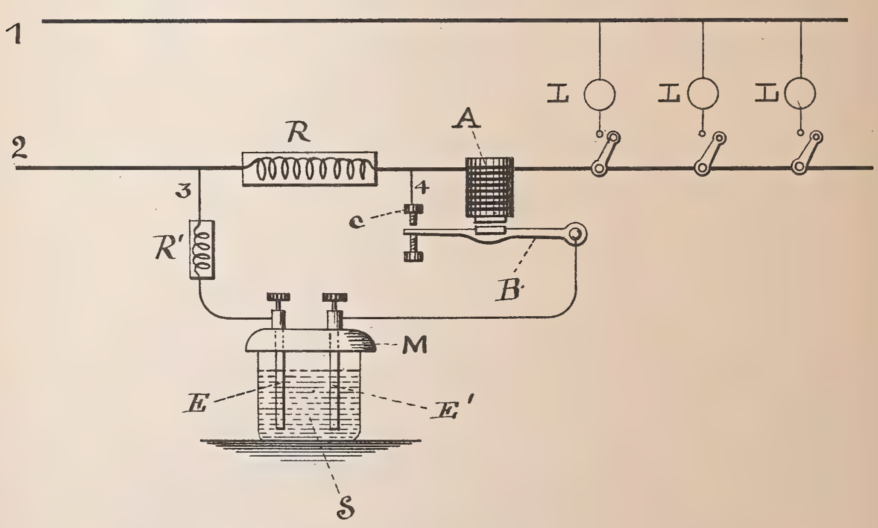
H. W. SEELY.

(No Model.)

T. A. EDISON.

WEBERMETER.

No. 281,352. Patented July 17, 1883.



WITNESSES:

D. W. Mott
W. J. Clagett

INVENTOR:

T. A. Edison

BY Dyer & Wilber

ATTORNEYS.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

WEBERMETER.

SPECIFICATION forming part of Letters Patent No. 281,352, dated July 17, 1883.

Application filed November 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Webermeters, (Case No. 356;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This improvement relates to the electroplating or metal-depositing cell electric meter for measuring the amount of electrical energy consumed in my system of electric lighting, in which meter the metal is taken from one electrode of the cell and is deposited upon the other by the action of the current. This depositing-cell is arranged so that only a small part of the current will pass through it, the total current being determined by the measurement of a definite fractional portion thereof, as set forth in my application filed March 20, 1880, (Serial No. 5,539.)

Now, the object of the present invention is to produce an electric meter of this character which will produce a correct deposit of metal by the use of a much weaker current (or smaller portion of the entire current) than is possible with the employment, as heretofore practiced by me, of simple copper electrodes, thus causing a considerable saving in electrical energy. This I accomplish by using amalgamated electrodes in the depositing-cell. The electrodes which I prefer to use, and which are the most accurate, are made of metallic zinc placed in a strong solution of sulphate of zinc. I prefer that such electrodes, before being used in the meter, should have a heavy coating of deposited zinc placed on them by the action of an electric current, which zinc will be thoroughly amalgamated while being deposited. This is done by coating the plates with mercury and then depositing the zinc thereon, and removing the plates from the depositing-cell and coating with mercury as often as is necessary to secure a thorough amalgamation of the zinc. Plates thus prepared are precisely alike and give accurate results. Other metals which can be amalgamated—such as cadmium, lead, and tin—are capable of being used in this connection when immersed in solutions of their salts, not acting upon the mercury, such as the sulphate of cadmium and acetate of lead; but none are as accurate as zinc treated as described. The depositing-cell meter is arranged in a shunt from one of the conductors of a house or other consumption circuit, a resistance being placed in the line to shunt a definite small portion of the entire current through the meter. A wire resistance is placed in the same shunt as the depositing-cell, and is arranged to compensate for the effect of changes in temperature on the resistance in the cell-circuit. The wire being increased in resistance by a rise of temperature, and the cell proportionately decreased, and a fall of temperature having exactly the opposite effect on the wire and cell, the total resistance of the shunt will always be the same, and consequently the same fraction of the current will always pass through it. Two or more depositing-cells may be used instead of one cell in the same shunt, or two cells may be placed in separate shunt-circuits, so that one will act as a check upon the other, as set forth in my application filed August 30, 1881, (Serial No. 40,990.) Although with the amalgamated-zinc electrodes there is the minimum amount of counter electro-motive force to the cell, still it is practically impossible to produce two electrodes which are so precisely alike that there will be no counter force at all.

To prevent the establishing by the cell of a counter current when no lamp is on and no current is flowing through the house or consumption circuit, I provide a device for automatically breaking the shunt when the circuit of the last lamp is broken and for closing such shunt when the first lamp-circuit is completed. This device may consist of an electro-magnet placed directly in the house or consumption circuit, or in a multiple-arc circuit therefrom, or in a shunt from one of the conductors of the consumption-circuit, and operating a lever arranged to make and break the meter-shunt; or this magnet may be the resistance around which the meter-shunt is placed.

The drawing shows a diagrammatic view of the meter and connections.

1 2 are the conductors of the house or consumption circuit, and L lamps or other translating devices placed in multiple-arc or derived circuits.

R is resistance in conductor 2.

3 4 represent the meter-shunt.

M is the depositing-cell forming the meter, having amalgamated-zinc electrodes E E′ and a solution of sulphate of zinc, S.

R′ is the wire resistance in shunt 3 4, to compensate for the varying resistance of S.

A is the electro-magnet in the conductor 2, operating lever B, placed in shunt 3 4, and making and breaking said shunt at contact *c*.

What I claim is—

1. In an electric meter, an electro-depositing cell provided with amalgamated metallic electrodes, substantially as set forth.

2. In an electric meter, an electro-depositing cell having amalgamated-zinc electrodes, substantially as set forth.

3. The combination, with an electro-depositing cell acting as a meter, of a circuit closer and breaker arranged to break the meter-circuit completely when no translating devices are in operation, and to close such meter-circuit completely when the first translating device is put in operation, substantially as set forth.

4. The combination, with an electric circuit including a definite and known resistance, of one or more electro-depositing cells arranged in a shunt around such resistance, and an electro-magnet in the main circuit, or in a shunt or multiple-arc circuit therefrom, operating to open and close the meter-shunt, substantially as and for the purpose set forth.

This specification signed and witnessed this 5th day of October, 1881.

THOS. A. EDISON.

Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 281,353. Patented July 17, 1883.

Fig. 1.

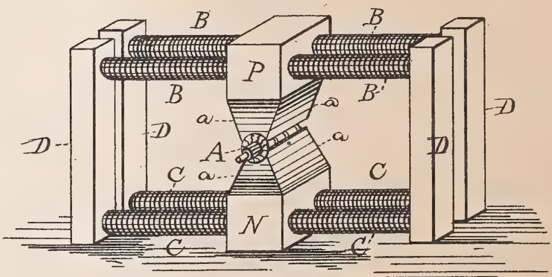


Fig 2.

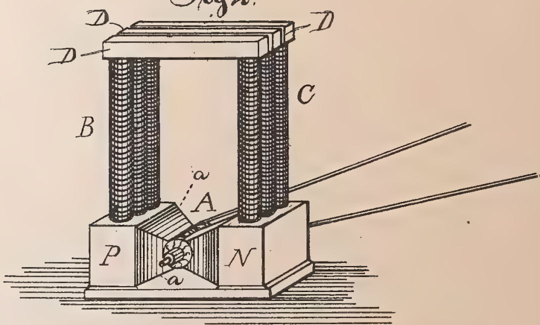


Fig 3.

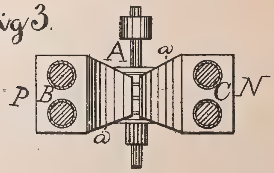
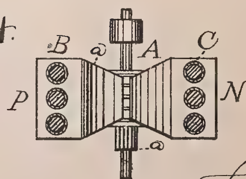


Fig. 4.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd N. Dyer

Atty.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 281,353, dated July 17, 1883.

Application filed September 13, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 434;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is such an improvement in dynamo or magneto electric machines that greater economy of construction may be secured and machines of greater efficiency obtained than heretofore for the same outlay. This I accomplish by contracting the field of force of the machines, and in this way increasing the lines of force or the strength of the lines of force per unit of surface of the armature. The armature is made to correspond in size with the active faces of the polar extensions, which nearly surround such armature. It will be seen that smaller armatures can be used, and that powerful machines may be built without the increase heretofore required in the size and cost of the armatures, and with but a small increase, comparatively, in the cost of the other parts of the machines, and also diminishing greatly the resistance of the armature. The contraction of the field of force is brought about by making the polar extensions smaller at their active opposing faces than at any other point, such polar extensions being made convergent in one or in two directions. One or more pairs of electro-magnet cores are attached to one or to each side of the polar extensions. Two or more pairs of cores are preferably thus attached to the same polar extensions, and are placed either in a horizontal or in a vertical position. Each pair of cores is provided with its separate magnetic yoke or back piece, while the polar extensions, to which all the pairs of cores are attached, are made each of one piece magnetically.

The foregoing will be better understood from the drawings, in which Figure 1 is a perspective view of a machine embodying the invention; Fig. 2, a perspective view of a somewhat different form of machine; Fig. 3, a vertical section through the cores on one side of the machine shown in Fig. 1, and Fig. 4 a horizontal section through the cores of the machine shown in Fig. 2.

A represents the revolving armature of a dynamo or magneto electric machine having a continuously-wound bobbin connected with the bars of a commutator-cylinder, as usual. This armature is supported, in the ordinary way, in the space between the opposing faces of the polar extensions P N of the field-of-force magnet or magnets. The active opposite faces of the polar extensions are curved to nearly surround the armature, which is made of proper size to fit in the chamber formed by the curved faces at the reduced ends of the polar extensions. These polar extensions have their bodies made of the proper size to receive the magnet-cores, while from these bodies the polar extensions are made convergent in one or two directions, or are contracted toward the field of force, the bevel surfaces being shown at *a*. This contraction may be made in one or in two directions, and from one or both sides of the polar extensions—that is to say, each polar extension may be beveled on one or both sides, or on one or both ends; or it may be beveled on one or both sides and on one or both ends at the same time. Two or more pairs of cores, B C, are preferably used, arranged on each side of the polar extensions, Fig. 1, or on one side only, Fig. 2, and connected with the bodies of the polar extensions. Each pair of cores has a separate magnetic yoke or back piece, D, as shown, while the polar extensions P N are magnetically each in one piece.

The armature, it will be seen, is made the size of the contracted ends or active faces of the polar extensions, and thus it can be made much smaller than heretofore, and, being the most expensive portion of the machine to construct, the machine is made cheaper than those of equal power heretofore constructed. It is evident that machines constructed in this way have corresponding advantages when used as electric engines or motors.

I do not claim herein the two or more cores or sets of cores attached to the same polar extensions and located at different distances from

the armature, as this is claimed in my application No. 71,757; and it is to be understood that all other patentable features of invention shown or described but not claimed herein are reserved for protection by other patents, and have been or will be embodied in other applications for patents.

What I claim is—

1. In a dynamo or magneto electric machine, the combination, with a revolving armature, of the field-magnet provided with convergent polar extensions nearly surrounding the armature, substantially as set forth.

2. In a dynamo or magneto electric machine, the combination, with the field-magnet and its polar extensions having reduced opposite active ends made with curved faces, of an armature revolving in the space formed by the curved faces of the reduced active ends of the polar extensions, and nearly surrounded by such curved faces, substantially as set forth.

3. In a dynamo or magneto electric machine, the combination, with a revolving armature, of a field electro-magnet composed of polar extensions, each of which is magnetically in one piece, and two or more pairs of wound cores attached to such polar extensions, and provided with magnetically-separate yokes or back pieces, substantially as set forth.

4. In a dynamo or magneto electric machine, the combination, with a revolving armature, of the field-magnet provided with convergent polar extensions nearly surrounding the armature, and two or more pairs of magnet-cores, substantially as set forth.

5. In a dynamo or magneto electric machine, the combination, with a revolving armature, of the field-magnet provided with convergent polar extensions made each in one piece magnetically and nearly surrounding the armature, and with two or more pairs of magnet-cores having separate magnetic yokes or back pieces, substantially as set forth.

This specification signed and witnessed this 3d day of June, 1882.

THOS. A. EDISON.

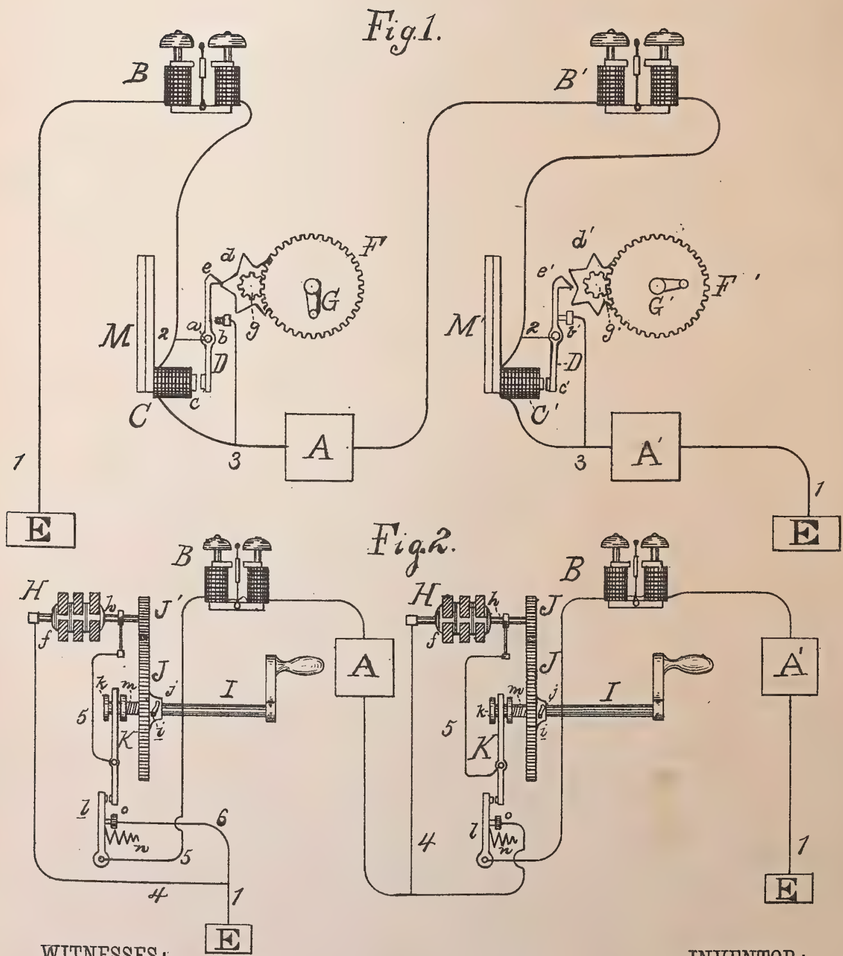
Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

MAGNETO ELECTRIC SIGNALING APPARATUS.

No. 282,287. Patented July 31, 1883.



WITNESSES:

E. C. Rowland,

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich^d N. Dyer, Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MAGNETO-ELECTRIC SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 282,287, dated July 31, 1883.

Application filed August 7, 1882. (No model.)

Corrections in Letters Patent No. 282,287.

It is hereby certified that in Letters Patent No. 282,287, granted July 31, 1883, to Thomas A. Edison, of Menlo Park, New Jersey, for an improvement in "Magneto-Electric Signaling Apparatus," an error appears requiring correction as follows: in line 94, page 2, of the printed specification, the following words should have been inserted after the word "generator," "and causing the coils of the generator;" and that the specification should be read with this correction therein to make it conform with the records of the case in the Patent Office.

Signed, countersigned, and sealed this 14th day of August, A. D. 1883.

[SEAL.]

M. L. JOSLYN,
Acting Secretary of the Interior.

Countersigned:

E. M. MARBLE,
Commissioner of Patents.

when such machine is not in use. This is accomplished by arranging the dynamo or magneto electric machine at opposite ends of the line in series with the electrically-operated alarms at opposite ends of the line. The generators may be thrown automatically into and out of circuit by providing means, in connection with each generator, which shall, immediately upon the operation of the generator, open a shunt around said generator, (the generator-circuit being always closed,) which shunt is normally kept closed, and returns to such normal condition immediately on the cessation of such operation.

The breaking of the shunt-circuit may be accomplished by means of a vibrating circuit-breaker whose vibrations are caused by the act of operating the generator, it being so arranged as to close the circuit when the generator is stopped; or means may be provided for holding the shunt-circuit open continuously during the operation of the generator. As such a shunt is practically of no resistance, its closure amounts practically to the throwing of the generator entirely out of circuit. Instead

In the annexed drawings, Figure 1 is a view, partly diagrammatic, of apparatus embodying my invention; and Fig. 2, a similar view of a modification of the same.

1 1 represent the main line, E E being the earth or ground connections. The squares A A′ represent telephones, and B B are the electrically-operated bells which produce the signals. These signal-bells are arranged in series in the main line, as shown.

In Fig. 1, C C′ are electro-magnets in series in the main line. The magnet C has a permanent magnet, M, or series thereof, attached to its cores, and is provided with an armature, *c*, the whole forming a magneto-electric generator, current being produced by the movement of the armature before the poles of the magnet. Such movement is produced by the following mechanism: A cog-wheel, F, turned by a crank, G, meshes with another cog-wheel, *g*, on the shaft of a star cam-wheel, *d*, having beveled pointed teeth, which engage with a point, *e*, on the end of an arm, D, to whose other end the armature *c* is attached. This

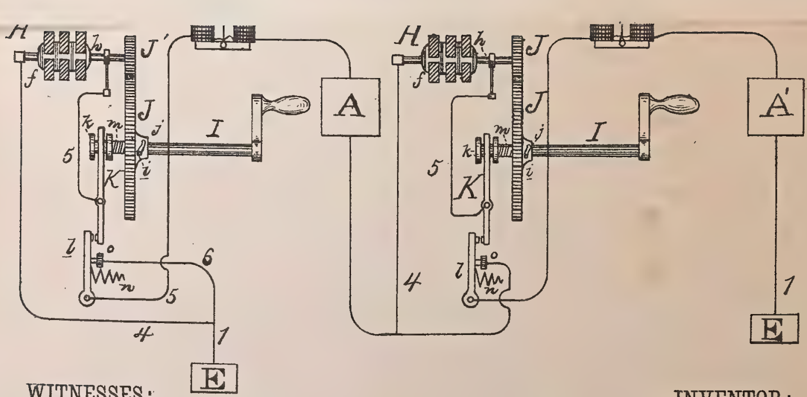
(No Model.)

T. A. EDISON.

MAGNETO ELECTRIC SIGNALING APPARATUS.

No. 282,287. Patented July 31, 1883.

Fig. 1



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich.d N. Dyer, Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MAGNETO-ELECTRIC SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 282,287, dated July 31, 1883.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Magneto-Electric Signaling Apparatus, (Case No. 470,) of which the following is a specification.

My invention relates to apparatus for transmitting signals by electricity back and forth over the same line, in which apparatus the current used for signaling is generated by dynamo or magneto electric machines, my object being to provide an arrangement of such machines and the alarms operated by them so that the alarms at both ends of the line will be operated simultaneously by the working of the dynamo or magneto electric machine at either end of the line, and to provide means, to be used in connection with each dynamo or magneto electric machine, controlled by the act of operating the machine, for automatically throwing it into circuit when in use and removing it when the operation ceases, it being desirable to remove the resistance of each dynamo or magneto electric machine from the circuit when such machine is not in use. This is accomplished by arranging the dynamo or magneto electric machine at opposite ends of the line in series with the electrically-operated alarms at opposite ends of the line. The generators may be thrown automatically into and out of circuit by providing means, in connection with each generator, which shall, immediately upon the operation of the generator, open a shunt around said generator, (the generator-circuit being always closed,) which shunt is normally kept closed, and returns to such normal condition immediately on the cessation of such operation.

The breaking of the shunt-circuit may be accomplished by means of a vibrating circuit-breaker whose vibrations are caused by the act of operating the generator, it being so arranged as to close the circuit when the generator is stopped; or means may be provided for holding the shunt-circuit open continuously during the operation of the generator. As such a shunt is practically of no resistance, its closure amounts practically to the throwing of the generator entirely out of circuit. Instead of this arrangement, however, the shunt may be dispensed with, and the same effect produced by closing the main line and opening the generator-circuit when the generator is not in use, and opening the main line and closing the generator-circuit when the generator is in use.

It is preferable that the generator and the circuit-breaker employed should be operated by a continuously-revolving movement, suitable devices being employed to convert this movement into a vibrating one in case a vibrating circuit-breaker is used.

It will be understood that by the arrangement described the dynamo or magneto electric machines at both ends of the line will be normally and while at rest out of circuit. By the working of either dynamo or magneto electric machine it will be thrown automatically into circuit (the generator at the other end of the line remaining out of circuit) and into series, with the alarms at both ends of the line, which will be sounded simultaneously. Upon the cessation of the operation the generator is thrown automatically out of circuit, leaving the apparatus in its normal condition, ready for the operation of either generator.

In the annexed drawings, Figure 1 is a view, partly diagrammatic, of apparatus embodying my invention; and Fig. 2, a similar view of a modification of the same.

1 1 represent the main line, E E being the earth or ground connections. The squares A A′ represent telephones, and B B are the electrically-operated bells which produce the signals. These signal-bells are arranged in series in the main line, as shown.

In Fig. 1, C C′ are electro-magnets in series in the main line. The magnet C has a permanent magnet, M, or series thereof, attached to its cores, and is provided with an armature, *c*, the whole forming a magneto-electric generator, current being produced by the movement of the armature before the poles of the magnet. Such movement is produced by the following mechanism: A cog-wheel, F, turned by a crank, G, meshes with another cog-wheel, *g*, on the shaft of a star cam-wheel, *d*, having beveled pointed teeth, which engage with a point, *e*, on the end of an arm, D, to whose other end the armature *c* is attached. This

arm D is pivoted at a, and is connected by a wire, 2, with the main wire 1. It is adapted also to make contact with a point, b, from which a wire, 3, runs also to the wire 1, a shunt-circuit, 3, thus being formed around the generator.

It will be seen that when the crank G is turned a vibrating movement is imparted to the arm D and armature c, so that a current is generated which operates the signal; but when the revolution of the crank ceases, the point e falls into one of the indentations of wheel D, and the circuit 2 3 is closed at b, such circuit 2 3 being a short-circuit around the generator. The magnet M will have sufficient power to hold the armature c and maintain the contact at b, although a spring may be employed to assist the magnet. A similar arrangement exists at the other end of the line, consisting of magnet C′, armature c', arm D′, contact b', and gearing G′ g' d'.

Instead of the arrangement of electro-magnets and permanent magnets shown, an electro-magnet could be used having a vibrating polarized armature, by which current would be generated in the coils of the electro-magnet.

Instead of using a vibrating circuit-breaker, means may be employed which will keep the circuit constantly broken during the operation of the generator. Such means are shown in Fig. 2, wherein H is a dynamo or magneto electric generator whose field-magnets are shown in horizontal section. Its armature f is mounted on a shaft, h, and is revolved by crank-shaft I through cog-wheels J J′; or two grooved wheels connected by a belt may be substituted for the cog-wheels.

The wheel J is loose on the shaft I, the connection between them being by a pin, i, attached to the shaft which enters an oblique slot, j, in the hub of the wheel J. The traveling of pin i in oblique slot j moves the shaft I longitudinally in one direction, while a spiral spring, m, is used to move it in the other.

The shaft I has a grooved collar, k, which holds the pivoted lever K, whose lower end makes contact with the end of a lever, l, provided with a spring, n, and making contact with point o. The main line 1 1 passes through the lever l and contact o, and the generator-circuit 4 5 is connected with the lever K.

When the crank-shaft I is turned, it will move longitudinally, and lever K will strike lever l, forcing it from contact o, and keeping it separated therefrom until the movement is stopped, when it will again make contact with o. This movement of lever K, forcing l from o, completes the generator-circuit at the same time that it opens the main line. A similar apparatus is placed at the other end of the line in series with the first.

Instead of giving the crank-shaft itself a longitudinal movement, a sleeve upon said shaft may be made to move, as in my application for a patent filed September 19, 1881, and either of these forms may be used in connection either with a shunt-circuit or with the main line and generator-circuit.

In all the arrangements described the electrically-operated alarms are located in series in the line, and so are the dynamo or magneto electric machines, both alarms being sounded when either machine is worked, and both machines being normally out of circuit, and being thrown automatically into and out of circuit in the manner already fully explained.

What I claim is—

1. In a magneto-electric signaling apparatus, the combination, with the line, of electrically-operated alarms located in series in such line, dynamo or magneto electric generators located in series with such alarms, means actuated automatically by the stopping of each generator for removing its coils from the resistance of the line, and means operated automatically by the action of moving each generator to make its coils a portion of the resistance of the line, substantially as set forth.

2. In a magneto-electric signaling apparatus, the combination, with a dynamo or magneto electric generator, of a vibrating circuit-breaker operated automatically by the movement of the generator to become at short intervals a portion of the resistance of the line, and means actuated automatically by stopping the movement of the generator for removing said coils from the resistance of the line, substantially as set forth.

This specification signed and witnessed this 5th day of August, 1882.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

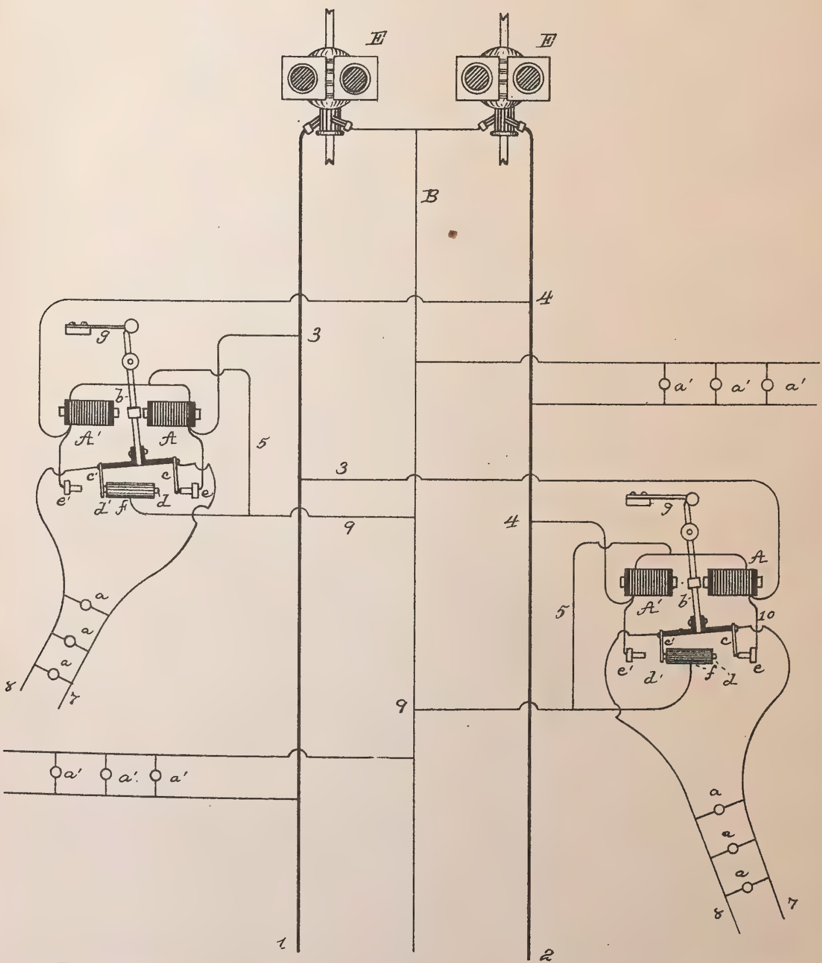
(No Model.) 3 Sheets—Sheet 1.

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 283,983. Patented Aug. 28, 1883.

Fig. 1.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Richd. N. Dyer,

Atty.

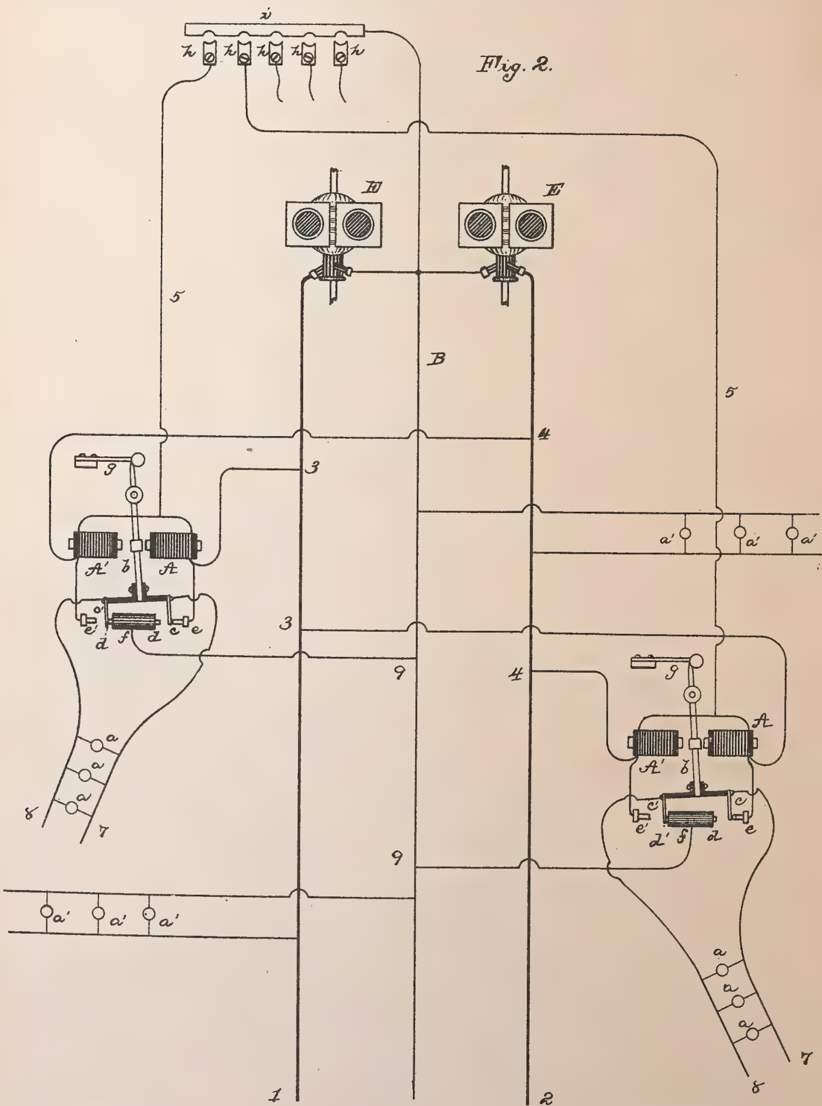
(No Model.) 3 Sheets—Sheet 2.

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 283,983. Patented Aug. 28, 1883.

Fig. 2.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich^d. N. Dyer. Atty

N. PETERS, Photo-Lithographer, Washington, D. C.

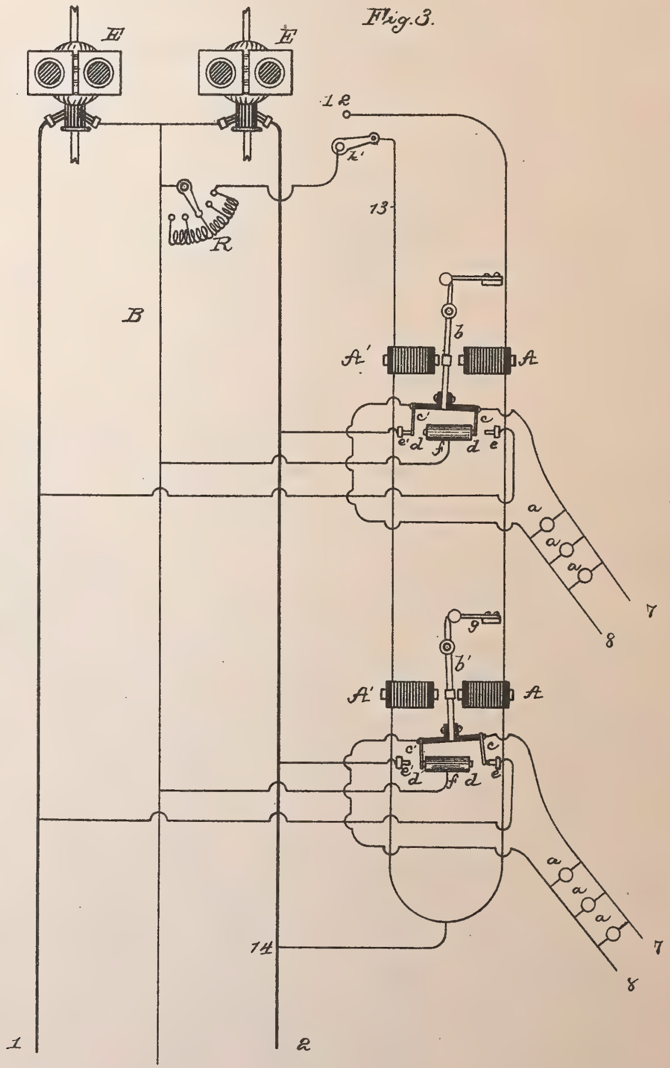
(No Model.) 3 Sheets—Sheet 3.

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 283,983. Patented Aug. 28, 1883.

Fig. 3.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 283,983, dated August 28, 1883.

Application filed April 17, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electrical Distribution, (Case No. 557,) of which the following is a specification.

This invention relates, mainly, to compensating systems of electrical distribution such as are described in my Patent No. 274,290, in which a divided source of electrical energy is employed to supply electric lamps or other translating devices arranged in multiple series, and a compensating conductor or conductors extend from between the translating devices to the point or points of division of the source of energy to preserve the balance of the system. The invention is also applicable, however, to those systems in which a main conductor is divided into series of branches, such branches containing the translating devices.

The object of the invention is to preserve, by devices either operating automatically or controlled from the central station or source of supply, the equality of the number of translating devices in the different parts or branches of systems of the character described. To accomplish this automatically I provide means controlled by variations in current, which, when the number of translating devices in one part of the system is too great, so that the current declines in such part, operate circuit-controlling devices, which shift a portion of the translating device from that part of the system to another, whereby the balance is maintained.

To control the devices from the central station, which may be preferable to the automatic operation, I may place each set in connection with a circuit running back to said station, so that by opening and closing such circuit the devices may be put in condition to be operated according to the preponderance of current in either part of the system; or I may place all the electric controlling devices which operate in the same direction and are arranged to be affected by different amounts of current in the same circuit, and vary the current in such circuit so as to throw into operation more or less of such controlling devices and shift a greater or less number of translating devices from one part of the system to another.

In the accompanying drawings is shown the application of my invention to a compensating system.

Figure 1 is a diagram illustrating the preferred automatic arrangement; Fig. 2, one showing the mode of controlling the devices from the central station, and Fig. 3 illustrates the mode of both controlling and operating the devices from the central station.

E E are dynamo-electric machines placed in series and forming the divided source of energy, the compensating-conductor B extending from the point of division. 1 2 are the main conductors. The circuits containing lamps or other translating devices, a, are arranged to be thrown from one side of the system to the other. The lamps a' are connected in permanent multiple-arc circuits, each connected to a main conductor and the compensating-conductor.

Referring to Fig. 1, A A′ are electro-magnets. Each magnet A is connected by conductor 3 and conductors 5 and 9 between the main conductor 1 and the compensating-conductor B. Each magnet A′ is similarly connected between main conductor 2 and conductor B by conductors 4, 5, and 9. Thus the magnet A is affected where there is an excess of current in main conductor 1, and magnet A′ when such excess occurs in conductor 2, by reason of the decrease in the number of translating devices on either side.

Between the magnets A A′ is the pivoted armature-lever b, which carries the two-armed circuit-controller c c'.

To the arm c is connected the conductor 7, and to arm c' the conductor 8, which form a circuit, across which the translating devices a a are arranged in multiple arc. Arm c plays between contact d and contact e, the latter of which is connected with main conductor through wire 3. Arm c' is placed between contacts a' and e', the latter being connected to conductor 2 through wire 4. Both contacts d d' are connected to compensating-conductor B by conductor 9, f being a metallic cylinder.

When the current in main conductor 1 is in excess of that in main conductor 2, it is desirable to shift a portion of the translating de-

vices from the latter to the former. The magnet A is energized by the excess of current and draws the armature *b* toward it, the ball and spring *g* assisting to throw the armature over, the arm *c* making contact with *e*, and the arm *c'* with *d'*, as shown. A circuit is thus formed, including the lamps *a*, from conductor 1 to conductor B *via* 3, 10, 7, 8, *f*, and 9.

When the current becomes stronger in conductor 2, the magnet A' is more greatly energized and draws the armature *b* toward it, closing circuit at *e'* and *d*, and thus placing the lamps *a* between the conductors 2 and B.

It is evident that as many sets of magnets A A', with devices controlled thereby, may be provided, as desired. Each house or building in the district may be so provided, or only a few arranged to preserve the balance to a sufficient extent. The magnets would be arranged to operate with different amounts of current, so that successive changes would be made as desired.

It is evident, also, that the invention can be as readily applied if the system is divided into more than two parts by more than one compensating-conductor.

The arrangement illustrated in Fig. 2 is the same as that just described, except that the conductors 5 of each set, instead of being connected directly with the compensating-conductor, runs to the central station, where it is connected with a contact-plate, *h*. Circuit is completed by the insertion of plugs between the plates *h* and plate *i*, which is connected by conductor 11 with the compensating-conductor.

Indicating circuits and devices are provided, as shown in my Patent 266,793, of October 31, 1882, to show the electrical condition at different parts of the system.

When it is desired to throw any set of translating devices into connection with the opposite side of the system, circuit is closed at *h i* to the set of controlling-magnets A A', which it is desired to operate, and that magnet will be affected which is in connection with the side having the preponderance of current, the effect being the same as before explained. The electrical devices are thus controlled from the station, but operated automatically.

In Fig. 3 the two magnets A are placed in series in a circuit, 12 14, and the magnets A' are similarly arranged in a circuit, 13 14. The switch *k* closes either of these circuits, as desired. The operation of the magnets upon the devices affected by them is similar to that described with reference to Fig. 1.

R is an adjustable resistance in the conductor which runs to the switch *k*. By adjusting this resistance the current in the circuit 12 14 or 13 14, as the case may be, is varied.

The magnets A are so arranged, either by difference of winding, difference in distance between magnet and armature, or otherwise, that a different amount of current is required to cause each magnet to attract its armature, and the magnets A' are similarly arranged with relation to each other. Hence by adjusting the resistance R to different extents more or less of the series of magnets which is in circuit at the time can be made to act and to throw the circuits controlled by them into connection with the opposite side of the system from before.

Suitable indicating devices are provided at the central station, as before explained.

As shown, the magnets A' are in circuit, but the current is insufficient to cause both to attract their armatures. By adjusting the resistance the other magnet may be caused to act, and the circuit controlled by it can be connected across the other side of the circuit. By this arrangement the devices are both controlled and operated from the central station.

It is evident that any desired number of magnets with their accompanying apparatus may be used.

It is evident that instead of using an adjustable resistance each magnet could be placed in a separate circuit, means being provided at the central station for closing the circuit of any magnet, as desired.

In applying this invention to a system in which feeding-conductors are used it is preferred to place near the extremity of each feeding-circuit, a number of the electrically-operated compensating arrangements indicating circuits being provided, as usual. When the indicators show too much or too little pressure at the terminals of any circuit, one or more of the magnets at that locality will be energized and caused to change the connection of the devices controlled by it.

In series systems wherein a main conductor is divded into two or more series of divisions or branches, each branch containing a translating device, and the source of energy not being divided, my invention may be applied to change the connection of a branch from one series to another. It is evident that this arrangement is the same as that in Fig. 1, except that the compensating-conductor B would not be connected between the generators, one generator being used alone, or two or more with ordinary series or multiple-arc connections.

In a compensating system, if the number of translating devices in the district becomes at any time so small that it can be supplied by one division of the source of energy, all such translating devices can be thrown onto one side of the district, the system becoming then an ordinary multiple-arc system, with the unnecessary generators out of use, and the compensating-conductor forming one of the main conductors of the system.

It is to be understood that all patentable features of novelty shown or described, but not claimed herein, are reserved for protection by other patents, and have been or will be included in other applications for patents.

What I claim is—

1. In a compensating system of electrical

distribution, the combination, with a translating device or group thereof, of automatically operated means for changing the connections of such device or group from one part of the system to another, to maintain the balance of the system, substantially as set forth.

2. In a compensating system of electrical distribution, the combination, with a translating device or group thereof, of electrically-operated means for changing the connection of such device or group from one part of the system to another, substantially as set forth.

3. In a compensating system of electrical distribution, the combination, with a translating device or group thereof, of means controlled from the central station for changing the connection of such device or group from one part of the system to another, substantially as set forth.

4. In a compensating system of electrical distribution, the combination, with a translating device or group thereof, of means, controlled from the central station and operated automatically by the current in the system, for changing the connection of such device or group from one part of the system to another, substantially as set forth.

5. In a compensating system of electrical distribution, the combination, with a translating device or group thereof, of oppositely-acting electro-magnetic devices energized by the current in the system, and circuit-controlling mechanism controlled by said electro-magnetic devices for changing the connections of such translating device or group from one part of the system to another, substantially as set forth.

6. In a compensating system of electrical distribution, the combination, with a translating device or group thereof, of two electro-magnets, one connected with each part of the system, and circuit-controlling devices controlled by said electro-magnets, whereby when the current in one part is stronger than in another, the connections of such translating device or group are changed from the weaker side to the stronger, substantially as set forth.

This specification signed and witnessed this 5th day of April, 1883.

THOS. A. EDISON.

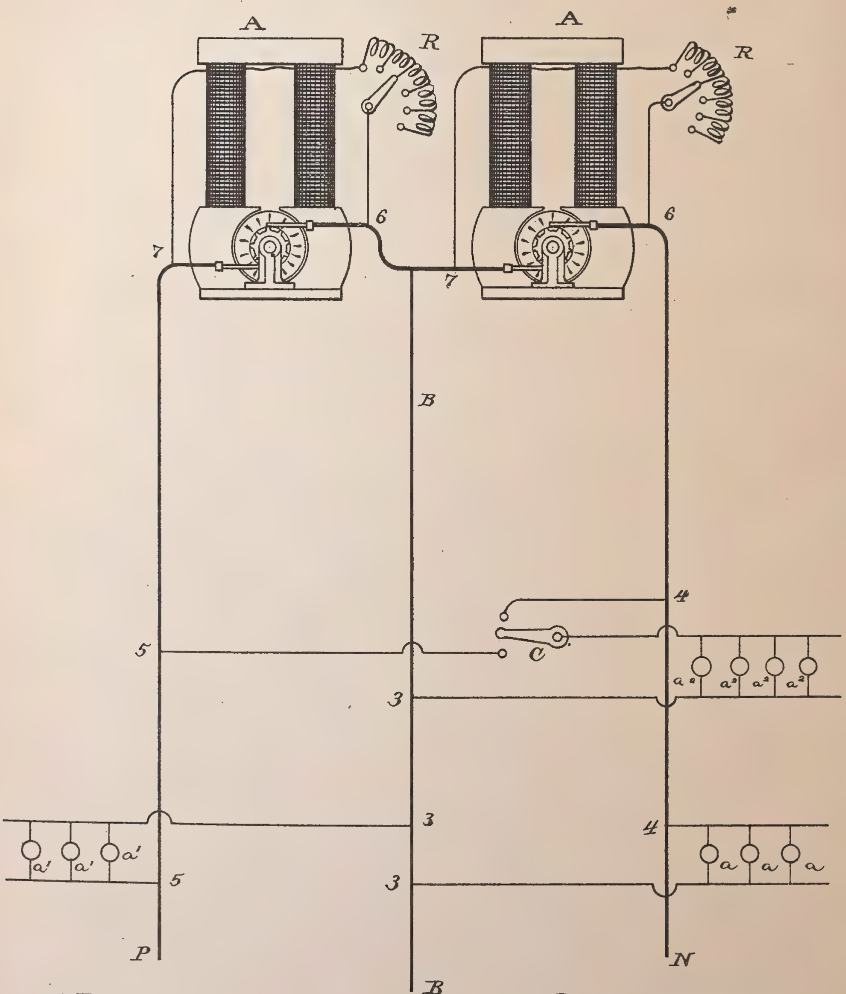
Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 283,984. Patented Aug. 28, 1883.



ATTEST:

E. C. Rowland

N. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,

Atty.

N. PETERS Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 283,984, dated August 28, 1883.

Application filed March 16, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electrical Distribution, (Case No. 551,) of which the following is a specification.

My invention relates to "compensating" systems of electrical distribution such as are set forth in my Patent No. 274,290, dated March 20, 1883, in which a divided source of energy is employed and one or more compensating-conductors extend from the points of division of said source and are connected between the translating devices arranged in multiple series across the main conductors.

The objects of my invention are to keep the electro-motive force equal in both or all the divisions of the system, and to prevent as much current as possible from traversing the compensating conductor or conductors.

In accomplishing these objects I provide each division of the source of energy with means for regulating its electro-motive force independent of the other divisions. Where two or more dynamo-electric machines are connected in series, each forming one division of the source, an adjustable resistance is preferably placed in the field-circuit of each machine for regulating its electro-motive force. Thus, if the drop in electro-motive force is greater on one main conductor than on the other, if one machine runs faster than the other, or if in any way the electro-motive force on one side becomes greater than on the other, the resistances in the field-circuits of the machines are independently adjusted to compensate for the difference, so that the same electro-motive force is constantly maintained. This keeps the lamps in the different divisions equal in candle-power, and also assists in preserving the balance of the system, keeping the current equal on the main conductor, and preventing it from flowing in the compensating conductor or conductors. If more than one generator is included in each division of the source of energy, such generators could all be regulated simultaneously by one or more adjustable resistances.

As stated in the application above referred to, the translating devices of the system are preferably arranged in such manner that the number on one side of the compensating-conductor will constantly remain about the same as that on the other.

In order to assist still further in preserving this equality, I may employ, in connection with a translating device or group of such devices, a switch or other means whereby such device or group may be transferred from one side of the system to the other, should the numbers become so unequal as to render such a change desirable.

The accompanying drawing is a diagram of a compensating system employing the above-described improvements.

A A are dynamo-electric machines connected in series and feeding into main conductors P N.

B is the compensating-conductor connected between the generators. The lamps or other translating devices, a, are placed across multiple-arc circuits 3 4, connected with compensating-conductor B and main conductor N, and translating devices a' are placed across the circuits 3 5 between said compensating-conductor and main conductor P. Each generator A has its field-coils in a muliple-arc circuit, 6 7, and each of such multiple-arc circuits contains an adjustable resistance, R. It is evident that by separately adjusting these resistances the electro-motive force on each side can be regulated separately, and consequently the candle-power of all the lamps in the system can be kept equal and at the proper point.

C represents any suitable switch or circuit controller. It is evident that by throwing such switch in one direction or the other the lamps a^2 may be connected with either side of the system, being either in a circuit, 3 4 or 3 5, as desired. It is evident that each house or building in the system, or any group of translating devices or single translating device may be provided with similar connections, whereby it can be placed in connection with either side of the system to maintain the balance.

In the system described in my application No. 538, (Serial No. 82,564,) in which the lamps of a building or locality are divided be-

tween two circuits, one connected with each side of the system, each of such circuits could of course be arranged to be thrown from one side of the system to the other, as in the present case. If the source of electric energy is divided into more than two parts and more than one compensating-conductor is used, each division of said source would be provided with its independent regulator, and the groups of translating devices could be provided with means for throwing them into connection with either part of the system—that is, for connecting them with a compensating-conductor and either main conductor, or between two compensating-conductors.

I do not claim herein the broad idea of regulating independently a number of electrical generators connected in series, as this is claimed in my prior application, No. 424, (Serial No. 68,641;) but

What I do claim is—

1. In a compensating system of electrical distribution, substantially as set forth, the combination, with the divided source of energy, of independent means for regulating the electro-motive force of each division of said source, substantially as set forth.

2. In a compensating system of electrical distribution, substantially as set forth, the combination, with the two or more dynamo or magneto electric machines connected in series and forming a divided source of energy, of an adjustable resistance in the field-circuit of each machine, substantially as set forth.

3. In a compensating system of electrical distribution, substantially as set forth, the combination, with a translating device or group of such devices, of means whereby such device or group can be connected with one division or another of the system, as desired, substantially as set forth.

4. In a compensating system of electrical distribution, substantially as set forth, the combination, with a multiple-arc circuit, including one or more translating devices, and having one terminal connected with a compensating-conductor, of means whereby the other terminal may be connected with either of the main conductors, substantially as set forth.

This specification signed and witnessed this 5th day of March, 1883.

THOS. A. EDISON.

Witnesses:

WM. H. MEADOWCROFT,

H. W. SEELY.

(No Model.)

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 283,985. Patented Aug. 28, 1883.

Fig. 1.

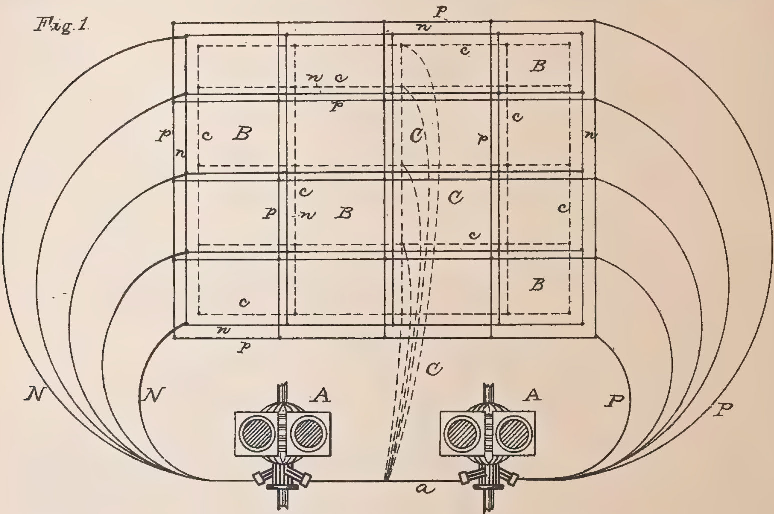


Fig. 2.

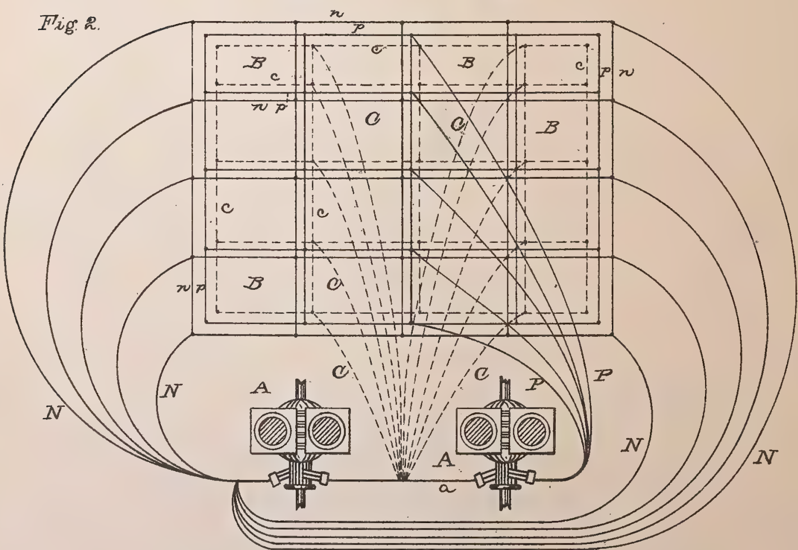
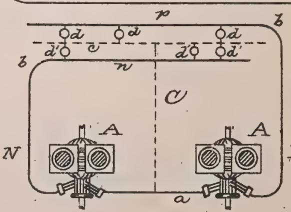


Fig. 3.



ATTEST:

E. C. Rowland,

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich^d N. Dyer,

Att'y.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 283,985, dated August 28, 1883.

Application filed January 22, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electrical Distribution, (Case No. 535,) of which the following is a specification.

My invention relates to systems of electrical distribution, such as are described in my application No. 520, (Serial No. 77,776,) wherein translating devices arranged in multiple series are made independently controllable by the use of a compensating conductor or conductors extending from the points of division of a divided source of electrical energy and connected between the translating devices in multiple series; and my invention consists, primarily, in the application of this compensating principle to a system of intersecting and connected positive and negative conductors to which current is conveyed by feeding-circuits containing no translating devices. Such feeding-circuits are preferably so arranged that all parts of the system will practically be electrically equidistant from the central station or source of energy, so that the same, or practically the same, pressure or electro-motive force will be maintained in all parts of the system without the use of adjustable resistances in the feeding-conductors.

In carrying my invention into effect the main conductors of the system are arranged in the manner set forth in several of my prior patents—that is, all the positive conductors are connected together at intersecting points, and likewise all the negative conductors.

The source of electrical energy may consist of any desired number of dynamo or magneto electric machines or other generators arranged in series or in multiple series. If one dynamo or magneto electric machine is used, one or more extra commutator-brushes are provided, from which the compensating-conductors extend for dividing the source of energy into the proper number of parts, and where two or more generators are placed in series the compensating-conductors are connected between them to the conductor which extends from one to another.

The several positive feeding-conductors which extend from the positive pole of the source of energy are preferably all connected at different points to the positive main conductor at one side or boundary of the district supplied, and all the negative feeders are correspondingly connected to the negative main conductor at the opposite side of the system. By this arrangement all the translating devices supplied from the same feeding-circuit are made electrically equidistant from the source of energy.

The conducting capacity of the feeding-conductors is so proportioned that all the points at which they are connected to the main conductors will be electrically equidistant from the source of energy—that is, those conductors which are connected at points near the source are made smaller than those which extend to a greater distance—so that the drop in electromotive force will be the same on all the feeding-circuits, such circuits, although of different lengths, being of practically the same resistance.

Throughout the system, parallel with the intersecting main conductors, extends a system of intersecting compensating-conductors, connected together at their intersecting points. The number of such compensating-conductors depends upon the number of translating devices in series, they being used to divide the multiple-arc circuits into a number of parts equal to the number of translating devices which it is desired to place in multiple series, which number, of course, varies according to the electro-motive force of the current used.

Each multiple-arc circuit which contains a translating device is connected across from a compensating-conductor to either a positive or a negative main conductor, the number of translating devices on each side of the compensating-conductor being as nearly equal as is conveniently practicable. The translating devices therefore are arranged in multiple series.

At the centers of the system—that is, at points midway between the junctions of the positive and negative feeding-conductors with the main conductors—are connected to the intersecting compensating-conductors one or more conductors, which extend to the source of energy, being connected at the points of division of such source. These I term the "main compensating-conductors."

As explained in the application above re-

ferred to, when differences occur in the number of translating devices in circuit on each side of a compensating-conductor the difference of current is taken up by such compensating-conductor, such current flowing therein in one direction or the other according to whether the preponderence is on the positive or on the negative side. Thus each translating device always receives a constant supply of current, and they are independently controllable, although arranged in multiple series.

Instead of connecting all the positive feeders at one side of the system and all the negative at the other, a portion of the positive (or negative) may be connected at one side and the remainder at the other, while all of the opposite kind are connected midway between them. In this case I employ two sets of main compensating-conductors, each set running to points midway between the pairs of feeding-conductors, but both sets being connected at the point of division of the source of energy.

My invention may be more readily comprehended by reference to the annexed drawings, in which Figure 1 is a diagram illustrating a system in which opposite feeding-conductors are connected to opposite sides of the district; Fig. 2, a diagram illustrating the system in which conductors of one kind are connected in the center and those of the other kind at the sides; and Fig. 3 is a diagram illustrating the principle of the invention.

Referring to Fig. 3, A A are dynamo or magneto electric machines, connected in series by a conductor, *a*. A positive conductor, P, and negative conductor N, extend from the respective poles of the series of generators. These may be considered as feeding-conductors as far as the points *b b*, the remainder, *p n*, being considered, respectively, as the positive and negative main conductors. Parallel with the main conductors *p n* is run a compensating-conductor, *c*, and a main compensating-conductor, C, runs from the center of conductor *c*, and is connected with conductor *a* between the generators. The multiple-arc circuits which contain translating devices *d* extend from the compensating-conductor *c* to the positive main conductor *p*, and the circuits containing devices *d'* extend from conductor *c* to negative conductor *n*. The translating devices *d* and *d'* are thus in multiple series, but are independently controllable by reason of the compensating-conductors C and *c*, as is fully explained in my prior application, above mentioned. It is evident that where currents of higher electro-motive force are used, so that more translating devices are placed in series, the source of energy would be divided into three or more parts, and two or more compensating-conductors would be used.

Referring, now, to Fig. 1, it is readily apparent that the complete system of electrical distribution there shown is merely a multiplication or extension of the arrangement illustrated in Fig. 3.

Instead of one positive conductor, P, and one negative conductor, N, a number of such conductors extend from the generators A A, and a series of intersecting positive and negative main conductors, *p* and *n*, are arranged surrounding the blocks B B of a town or village or district thereof. The feeding-conductors are connected on opposite sides of the systems, those of each pair terminating at points opposite to each other and at the same distance from the source of supply. The conductors of those pairs which terminate near the source of supply are of smaller mass than those which extend to a greater distance, in order that the electro-motive force may be the same in all parts of the system. A system of intersecting and connected compensating-conductors, *c*, are arranged parallel to the main conductors *p n*, and the connections of the circuits which contain translating devices are made as illustrated in Fig. 3. The main compensating-conductors C are connected to one of the compensating-conductors *c* midway between the positive and negative feeding-circuit terminals, there being as many conductors C as there are feeding-circuits P N, so that all the intersecting compensating-conductors are connected to the divided source of energy, all the conductors C being connected at the same point to the conductor *a*.

It will be seen that by this arrangement of conductors the electro-motive force, and consequently the relative candle-power, of the lamps in every part of the system will remain equal and constant, while the compensating-conductors cause the lamps in series to always receive the same current, although one or more of the same series may be thrown out of circuit.

The generators A A should be provided with suitable means for regulating their electro-motive force according to the whole number of translating devices in circuit throughout the system.

The arrangement shown in Fig. 2 is similar in principle to that in Fig. 1. In the former a portion of the negative feeding-conductors N are connected at one side of the district and the remainder at the opposite side, while all the positive feeders P are connected at the middle of the district between the negative ones. Thus the translating devices in both halves of the district are practically electrically equidistant from the central station. Two sets of main compensating-conductors are used, connected, as shown, midway between the positive and negative terminals, and all running to the same point in conductor *a*. Of course in both arrangements the number of intersecting compensating-conductors would be increased according to the number of translating devices placed in series, as explained with reference to Fig. 3.

What I claim is—

1. A system of electrical distribution having in combination the following elements, viz: a divided source of electrical energy, one or more feeding-circuits extending therefrom,

a series of intersecting and properly-connected positive and negative main conductors to which said feeding-circuits are connected, translating devices in multiple series, a series of intersecting compensating-conductors, and one or more main compensating-conductors extending from said intersecting compensating-conductors to the point or points of division of the source of energy, substantially as set forth.

2. In a system of electrical distribution, the combination of the divided source of energy, the intersecting and properly-connected main conductors, feeding-conductors extending from said source and connected to said main conductors at points electrically equidistant from said source, translating devices arranged in multiple series, and a system of intersecting and main compensating-conductors, substantially as set forth.

3. In a system of electrical distribution, the combination of a divided source of energy, a system of intersecting and properly-connected positive and negative main conductors, a system of intersecting compensating-conductors, one or more feeding-circuits, the conductors of each feeding-circuit being connected to the main conductors at different points, and one or more main compensating-conductors, one connected to the intersecting compensating-conductors at a point intermediate between the conductors of each feeding-circuit, substantially as set forth.

This specification signed and witnessed this 13th day of January, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

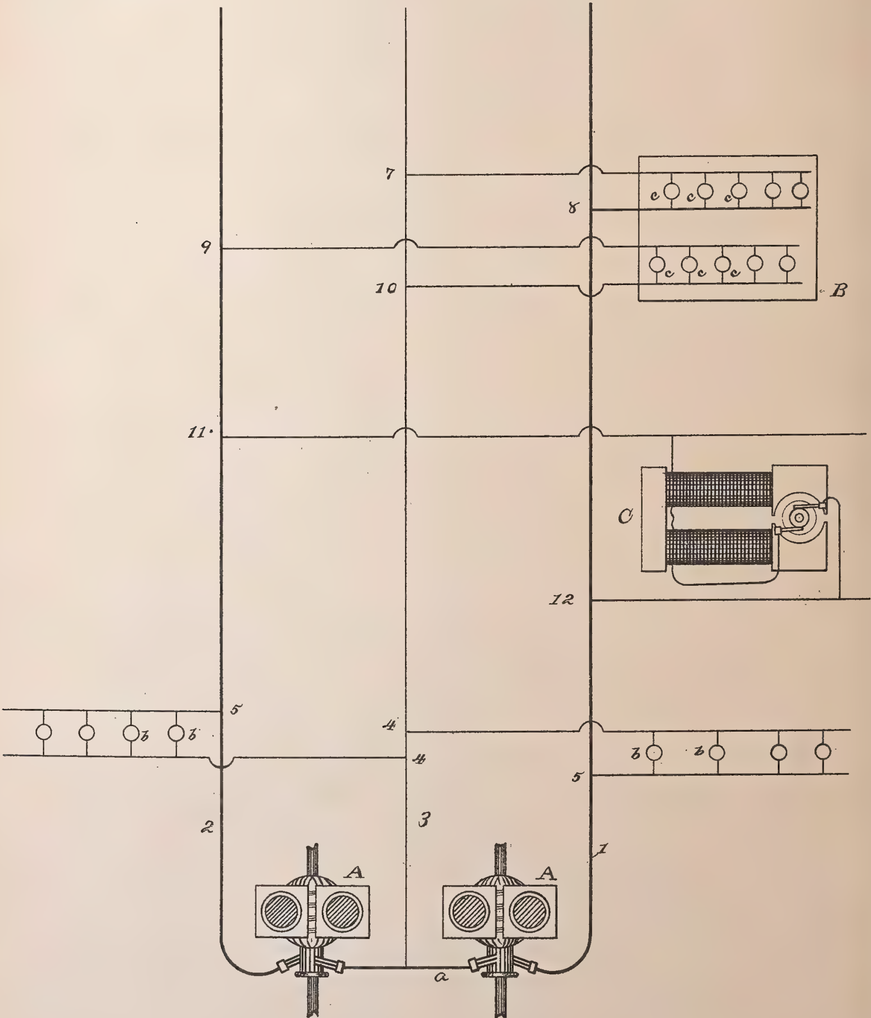
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 283,986. Patented Aug. 28, 1883.



ATTEST:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison
By Rich^d N. Dyer.
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 283,986, dated August 28, 1883.

Application filed January 22, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electrical Distribution, (Case No. 538,) of which the following is a specification.

My invention relates to such systems of distribution of electric energy for illumination, motive power, &c., as are set forth in my application No. 520, (Serial No. 77,776)—that is, to a system in which a divided source of energy is employed supplying translating devices arranged in multiple series, one or more compensating-conductors being provided whereby said translating devices are made independently controllable, and the system is divided into two or more parts. Such a system I term a "compensating" system of electrical distribution. In such a system, as explained in the application referred to, when one or more translating devices are thrown out of circuit in one part of the system, so that the numbers in the different parts become unequal, the current which would otherwise be supplied to said translating devices traverses said compensating-conductor in one direction or the other. It is, however, desirable that as little current as possible should ever traverse a compensating-conductor, so that such conductors may be made as small as possible, and it is therefore desirable to preserve the balance of the system—that is, to keep equal numbers of translating devices in circuit between the compensating-conductor and each main conductor, and also between two compensating-conductors, if more than one of such conductors are used. To accomplish this is the object of my invention.

This invention is intended to be applied to cases where a considerable number of translating devices are thrown into or out of circuit simultaneously—as, for instance, the lights in a theater or similar place—or where a single translating device, consuming a large amount of current—such as a large electro-dynamic motor—is placed in and out of circuit, the balance of the system being thus destroyed and a large amount of current being caused to traverse the compensating-conductor; or in a store or any other place employing a greater or less number of lamps which are not turned off simultaneously, but one or more at a time in different parts of the place, my invention is equally applicable.

Said invention consists in providing in a compensating system such connections that when one or more translating devices are thrown out of circuit the balance of the parts of the system will be self-preserved, and but little current will traverse the compensating conductor or conductors in either direction.

My invention may be practically carried into effect in the manner illustrated in the annexed drawing, which is a diagram of a compensating system embodying said invention.

A A are dynamo or magneto electric machines forming the source of energy of the system and placed in series, being connected by a wire, *a*.

1 2 are main conductors extending from the source of energy, and 3 is the compensating-conductor, connected to the wire *a* and dividing said source into two parts. Multiple-arc circuits 4 5 extend from the main circuit, each multiple-arc circuit being connected to the compensating-conductor and to one of the main conductors. Each of such multiple-arc circuits contains translating devices *b b*, each translating device on one side of the system being, it is evident, in series with one on the other side. When a translating device is thrown out of circuit on one side, a certain amount of current traverses the compensating-conductor. This illustrates what has hitherto been the ordinary arrangement of a compensating system. To constantly preserve the balance or general average of the two parts of the system, I employ the connections now to be described.

B represents a building or any place in which all the lamps *c c* are under the same control. I divide all said lamps, making as nearly an equal division as possible, between the two multiple-arc circuits 7 8 and 9 10. The circuit 7 8 is connected to main conductor 1 and compensating-conductor 3, and circuit 9 10 to main conductor 2 and to said compensating-conductor. By this arrangement, if all the lamps *c* are simultaneously thrown into or re-

moved from circuit, there is practically no change in the relative number of translating devices in the two parts of the system, little or no current traverses the compensating-conductor, and a constant balance of the system is automatically preserved. The building B may, however, be one in which the lights are thrown on and off a few at a time—as, for instance, in a store where at certain hours a large number of lights are required, while at other times less numbers are required and lights are extinguished in different parts of the store. In this case the lamps *c c* are arranged on the two circuits 7 8 and 9 10 in such manner that as lamps are gradually extinguished about as many will be thrown off on one circuit as on the other, keeping the numbers nearly equal and preserving the general average in the two parts of the system; or, if in this store this should not be the case, some other store, with its circuits similarly arranged and supplied from the same main circuit, would, in extinguishing its lights, produce the desired compensation and preserve the balance.

C represents a large electro-dynamic motor, consuming a large amount of current, and of such resistance that it may be placed directly across the multiple-arc circuit 11 12. If such motor were placed across one of the ordinary circuits 4 5 of the system, its removal would cause all such current to traverse the compensating-conductor. Therefore I place it in a multiple-arc circuit, 11 12, connected to the two main conductors 1 2, but not to the compensating-conductor 3. Thus its removal from circuit still keeps the balance on the opposite sides of the system equal, and does not affect the amount of energy which traverses the compensating-conductor.

It is evident that where it is desired to place more than two translating devices in series, and the system is divided into more than two parts, two or more compensating-conductors being used, my invention is equally applicable. For, if two compensating-conductors are employed, the lamps *c* would be nearly equally divided between three separate circuits, two of which are connected each to a main conductor and a compensating-conductor, and the third to the two compensating-conductors, while the motor C would still be connected to the two main conductors, as in the drawings, and these arrangements could of course be carried out with any number of compensating-conductors.

What I claim is—

1. In a compensating system of electrical distribution, the electric lamps of a building, divided between the two or more parts of the system, substantially as and for the purpose set forth.

2. In a compensating system of electrical distribution, the combination, with the main and compensating conductors, of two or more multiple-arc circuits containing electric lamps, entering the same building, and connected to the main and compensating conductors in such manner that the lamps of the building are divided between the parts of the system and the balance of the system is constantly preserved, substantially as set forth.

3. In a compensating system of electrical distribution, the combination, with the source of energy and main conductors, of lamps arranged in multiple series, compensating-conductors extending from between the lamps to the source of energy, and translating devices arranged in separate circuits between the main conductors without connection with such compensating-conductors, substantially as set forth.

This specification signed and witnessed this 13th day of January, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

EDWARD H. PYATT.

(No Model.)

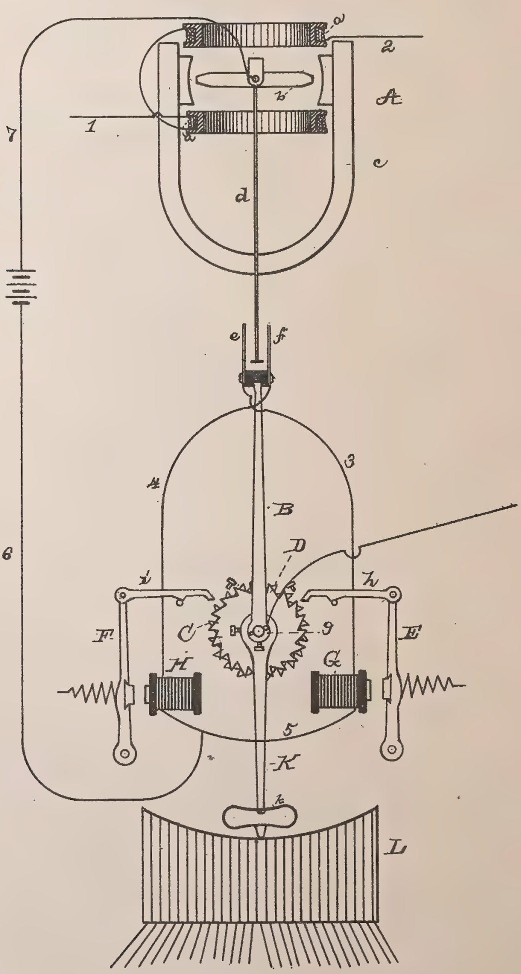
2 Sheets—Sheet 1.

T. A. EDISON.

ELECTRIC REGULATOR.

No. 287,511. Patented Oct. 30, 1883.

Fig. 1.



ATTEST:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer,
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.)

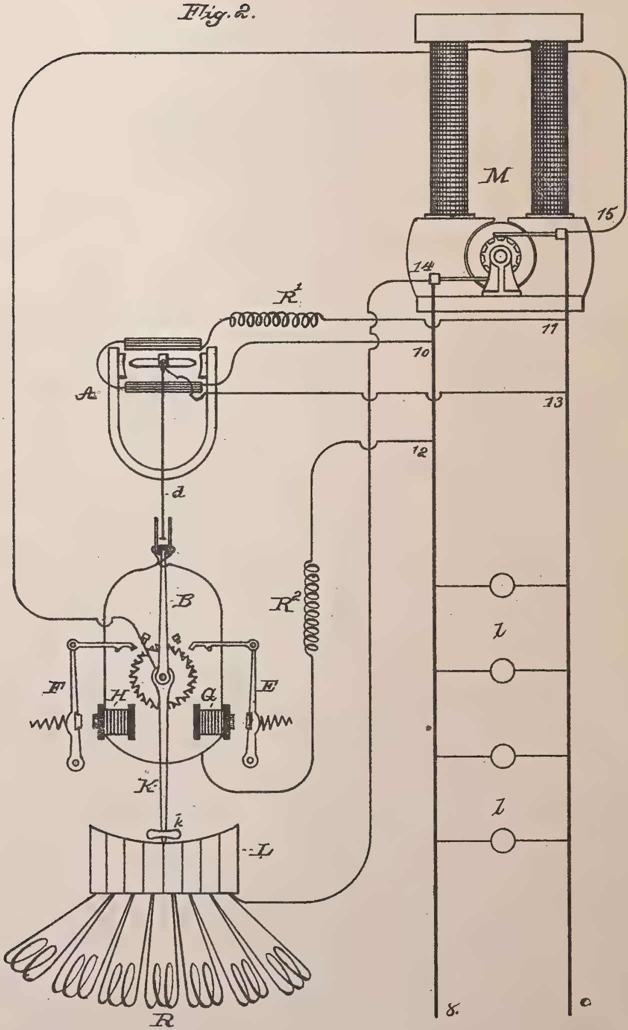
2 Sheets—Sheet 2.

T. A. EDISON.

ELECTRIC REGULATOR.

No. 287,511. Patented Oct. 30, 1883.

Fig. 2.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich^d N. Dyer,
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N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC REGULATOR.

SPECIFICATION forming part of Letters Patent No. 287,511, dated October 30, 1883.

Application filed June 29, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Regulators, (Case No. 583,) of which the following is a specification.

The object I have in view is to obtain simple and efficient means for producing movement by variations in the electro-motive force of the current of an electrical circuit, which means will be exceedingly sensitive in their action, responding with great exactness to the variations in the electro-motive force of the current; and my object herein is more especially to provide simple, efficient, and sensitive means for regulating, automatically, the electro-motive force of one or more dynamo or magneto electric machines, and particularly when such a machine is used to supply incandescing electric lamps arranged in multiple arc. This I accomplish by the employment of a galvanometer the coils of which are located in the circuit, the variations of whose current are utilized to set the moving devices in action, and the bar or needle of which carries an arm making and breaking circuit at moving contacts. The galvanometer-arm closes at the moving contacts circuits to devices which move such contacts in the same direction as the galvanometer-arm, but away from the same, breaking contact with such arm, which continues to follow up the contact and make the circuit after each break until the entire deflection in that direction due to the variation in the current is accomplished. The reverse movement of the galvanometer-arm produces a movement of the contacts in the opposite direction. These contacts are preferably two springs carried by an insulating-head mounted upon a pivoted arm. The end of the galvanometer-arm plays freely between these springs. The arm carrying the contacts is secured to a shaft on which are mounted two ratchet-wheels with teeth turned in opposite directions. Pawls carried by armature-levers work in the teeth of these ratchet-wheels. The coils of the electro-magnets operating these armatures are in circuit each with one of the spring-contacts. The other ends of the coils of these two magnets are connected together and form one side of a local circuit, the other side of which extends to the galvanometer-arm. By this arrangement a positive motion can be obtained, corresponding closely to the sensitive movement of the galvanometer-arm, without destroying the sensitiveness of such galvanometer by any unusual friction opposing its movement. The particular use herein explained to which this movement is applied is that for regulating the electro-motive force of one or more dynamo or magneto electric machines; but the movement may also be applied to various other uses—as, for instance, to the operation of electrical meters; but, although such other uses are included in the broad scope of this invention, they are not herein specifically claimed, such specific matter being reserved for protection by other patents.

In the application of the devices described to the regulation of dynamo or magneto electric machines, the coils of the galvanometer are located in circuit from the machine. If the machine is employed to supply incandescing electric lamps arranged in multiple arc, the galvanometer-coils are located in a multiple-arc circuit with or without extra resistance, as desired, so that such coils will be affected the same as any one of the lamps by variations in the electro-motive force of the current, caused either by changes in the number of translating devices or in the speed of the engine. The local circuit closed by the galvanometer-arm may be supplied by a galvanic battery, or be a multiple-arc or other circuit from the conductors supplied by the machine, it being only necessary that sufficient current should be supplied to work the magnets. The shaft of the ratchet-wheels is provided with a second arm, which makes contact with the vertical plates of a resistance-commutator, and by moving thereon throws resistance into and out of the field-circuit of the machine.

In the accompanying drawings, forming a part hereof, Figure 1 is a separate view, partly diagrammatic, of the apparatus; and Fig. 2, a view partly diagrammatic, showing the apparatus applied to the regulation of a dynamo-electric machine.

With reference more especially to Fig. 1,

A is a galvanometer of any suitable construction, having coils *a* arranged in circuit 1 2. In the galvanometer shown a soft-iron needle or bar, *b*, is used, pivoted between the poles of a permanent magnet, *c;* but the constant field of the galvanometer may be produced by a coil of wire or in any other well-known way. The arm *d* projects from the pivoted bar *b*, and plays freely at its ends between contact-springs *e f*, carried by an insulating-head on an arm, B. This arm is secured to a shaft *g*, to which are also secured two ratchet-wheels, C D, with teeth turned in opposite directions, as shown. Pawls *h i*, carried by armature-levers E F, work in the teeth of wheels C D, and these armature-levers are drawn forward by electro-magnets G H, and are retracted by springs. One end of the coils of G is connected with *e* by wire 3, while one end of the coils of H is connected with *f* by wire 4. The other ends of the coils of these two magnets are connected together by wire 5 and to a local battery, I, or other source of electrical energy by wire 6. The other pole of I is connected by wire 7 to the pivot of the bar or needle *b*. Movement will be produced in the manner already explained. The shaft *g* will preferably be arranged in line with the pivot of the needle or bar *b*, or nearly so, and the arm B will project above or below the galvanometer-arm *d* and in the same direction, the springs *e f* being bent downwardly or upwardly to embrace the end of the arm *d;* but for clearness of illustration the parts are arranged as shown, and they may be so used, although the other arrangement just mentioned is preferred. The application of this apparatus to the regulation of a dynamo-electric machine is shown in Fig. 2, to which reference is now made, as well as to Fig. 1. The shaft *g* has secured thereto another arm, K, carrying a spring contact-piece, *k*, working on the vertical plates of the commutator L, connected to the sections of a resistance, R.

M is a dynamo-electric machine, from which extend conductors 8 9, having electric lamps, motors, or other translating devices, *l*, located in multiple-arc circuits therefrom. The coils of the galvanometer are in a multiple-arc circuit, 10 11, from 8 9, an extra resistance, R′, being used or not, as desired. The magnets G H and galvanometer-arm are in a multiple-arc circuit 12 13 from 8 9, with extra resistance R^2. The field-circuit 14 15 of the machine is a multiple-arc circuit from 8 9, including the resistance R and the arm K′.

The operation will be understood from the foregoing description.

I do not claim herein the resistance-commutator composed of plates set on edge, since the same is covered by my application No. 78,775; nor do I claim herein the multiple-arc arrangement of the several elements, since the same is covered by my application No. 68,630; and it is to be understood that all patentable features of invention described or shown but not claimed herein are reserved for protection by other patents, and have been or will be embraced in other applications for patents.

What I claim is—

1. The apparatus for producing movement by the variations in electro-motive force of an electric current, consisting of a galvanometer affected by such current, moving contacts at which the galvanometer-arm closes circuit, and electrically-operated devices in circuit from said contacts, for moving said contacts away from said arm to break the circuit, substantially as set forth.

2. The combination, with a galvanometer, of moving contacts between which the galvanometer-arm plays, electrically-operated devices moving such contacts, and an electrical circuit including the galvanometer-arm, the moving contacts, and said electrically-operated devices, substantially as set forth.

3. The combination, with a galvanometer-arm included in an electrical circuit, of another arm following the movement of such galvanometer-arm, and electrically operated devices moving such second arm, the circuit to said electrically-operated devices being closed by the galvanometer-arm, substantially as set forth.

4. The combination, with a galvanometer-arm, of another pivoted arm, carrying on its free end insulated contacts between which the galvanometer-arm plays, two electro-magnets located in circuit with such contacts and operating pawl-levers, and oppositely-arranged ratchet-wheels worked by such pawl-levers and moving said second pivoted arm, the circuit of the electo-magnets being closed at the moving contacts by the galvanometer-arm, substantially as set forth.

5. The combination, with a dynamo-electric machine, of a regulator therefor, consisting of a galvanometer located in circuit from the machine, and closing at moving contacts local circuits to the regulator-operating devices, and to electrically operated devices for moving such contacts away from the galvanometer-arm, substantially as set forth.

6. The combination, with a dynamo or magneto electric machine, of an adjustable resistance for primarily varying the current flowing through its field-circuit, electrically-operated devices adjusting such resistance, and a galvanometer in circuit with the machine and controlling the circuits of such electrically-operated devices, substantially as set forth.

7. The combination, with a dynamo-electric machine, of translating devices located in multiple-arc circuits therefrom, the field-magnet coils of the machine, also in a multiple-arc circuit from the circuit supplied by the machine, an adjustable resistance in said field-circuit, electrically-operated devices adjusting such resistance, and a galvanometer located in a

multiple-arc circuit and controlling the circuits to such electrically-operated devices, substantially as set forth.

8. The combination, with a dynamo or magneto electric machine, of the galvanometer in circuit therefrom, the pivoted arm carrying contacts controlled by the galvanometer, the electro-magnets working such arm, and the resistance adjusted by such arm, substantially as set forth.

This specification signed and witnessed this 25th day of June, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

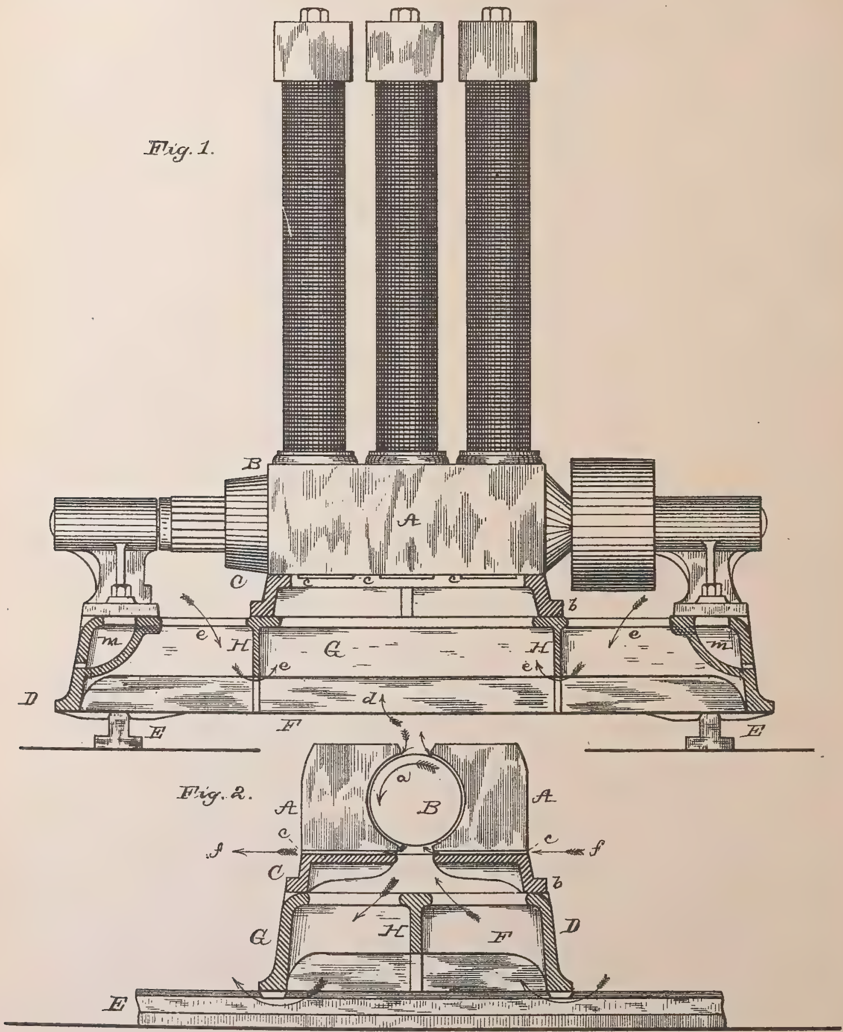
EDWARD H. PYATT.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 287,512. Patented Oct. 30, 1883.



ATTEST:
Edw. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Rich. N. Dyer,
Atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 287,512. Patented Oct. 30, 1883.

Fig. 3.

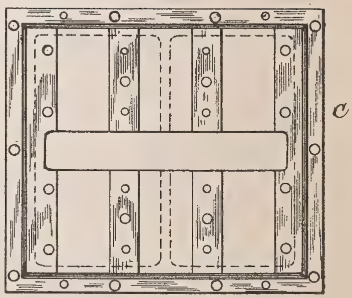
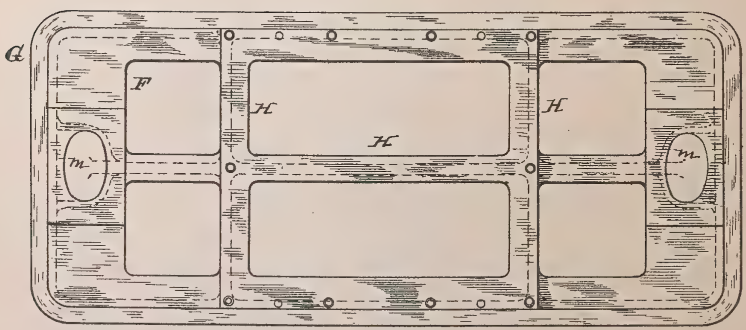


Fig. 4.



ATTEST:

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H. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich^d. N. Dyer,

Atty.

N PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 287,512, dated October 30, 1883.

Application filed June 29, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines, (Case No. 577,) of which the following is a specification.

This invention relates to the bed-plates on which dynamo-electric machines are mounted, its object being to maintain a circulation of air about the armature and between the armature and pole-pieces of the machine, whereby undue heating of the armature is prevented; and I accomplish this object by providing openings in the bed-plate upon which the machine rests, which openings permit air to penetrate to the space between the polar extensions in which the armature revolves. The bed-plate is preferably of iron, having a smaller plate of non-magnetic material, preferably zinc, placed upon it, to separate it from the magnet-poles. Both plates are made in the form of ribbed frames, the bed-plate being mounted upon ways, so that the air penetrates under it and through it and the zinc plate to the armature and polar extensions. Both plates are made of as open a form as is consistent with the proper degree of strength.

The invention is illustrated in the annexed drawings, in which—

Figure 1 is an elevation of a dynamo-electric machine with the bed-plates in longitudinal vertical section; Fig. 2, a vertical transverse section of the plates; Fig. 3, a plan view of the zinc plate, and Fig. 4 a plan view of the iron bed-plate.

A A are the polar extensions of the field-magnet of the machine, between which the armature B revolves in the direction shown by arrow *a*.

C is the zinc plate or frame, whose lower edge, *b*, rests upon the iron bed-plate D. The polar extensions A A rest upon the zinc plate C, whose upper edge is provided with apertures *c c*.

The plate D is set upon ways E E, (whereby it may be moved to tighten the belt connecting it with the source of power, as set forth in another application made by me,) and the air is thus enabled to penetrate beneath it. Such plate D is an open frame composed of an open bottom part, F, with raised sides G G. The bottom of the plate rests on the ways E E. Longitudinal and transverse ribs H H extend across, forming a rigid frame.

Upon the plate D is set the zinc plate C, which also consists of an open ribbed frame, on which the polar extensions rest.

The lower bed-plate, D, is provided with oil-receptacles *m m*, to which the oil is conveyed from the bearings. This feature will, however, be included in another application.

The arrows in Figs. 1 and 2 show the air circulation when the armature is revolving in the direction indicated. Air will enter below the plate D and pass through both plates to the armature, as shown by arrow *d*. It will enter, also, as shown by arrows *e*, at the top of the plate D, passing down, and then up through the center of the plate to the armature; and, also, the air will pass to and around the armature through the apertures *c* at the top of the zinc plate, as shown by arrows *f*.

It is to be understood that all patentable features of invention shown or described, but not claimed herein, are reserved for protection by other patents, and have been or will be included in other applications for patents.

What I claim is—

1. The combination, with a dynamo-electric machine, of an open bed-plate therefor, through which air penetrates to the space between the polar extensions of the machine in which the armature revolves, substantially as set forth.

2. The combination, with a dynamo-electric machine, of a bed-plate provided with openings and mounted upon ways, substantially as set forth.

3. The combination, with a dynamo-electric machine, of an open iron bed-plate and an open non-magnetic plate between said iron plate and the field-magnet of the machine, substantially as set forth.

4. The non-magnetic plate provided with apertures in its upper edges for admitting air to the armatures, substantially as set forth.

5. The combination, with a dynamo-elec-

tric machine, of a bed-plate therefor, formed as a ribbed frame and mounted upon ways, substantially as set forth.

6. The combination, with a dynamo-electric machine, of a non-magnetic plate placed between the polar extensions of the machine and the iron bed-plate, and formed as a ribbed frame, substantially as set forth.

This specification signed and witnessed this 25th day of June, 1883.

THOS. A. EDISON.

Witnesses:
H. W. SEELEY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 287,513. Patented Oct. 30, 1883.

Fig. 1.

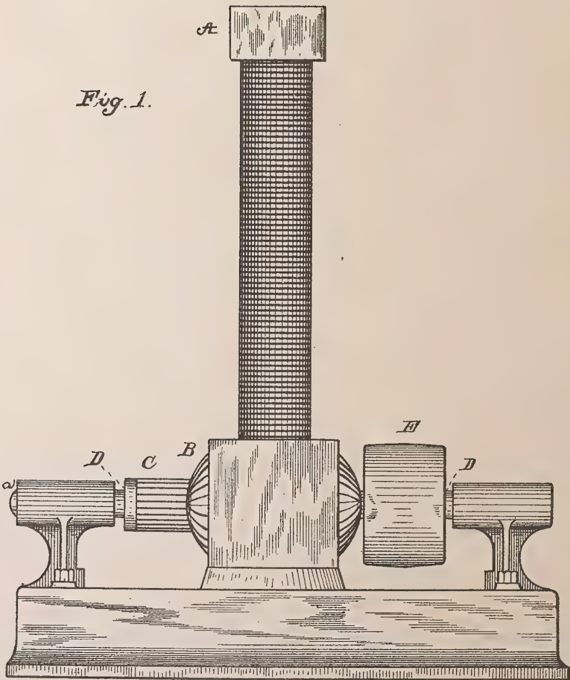
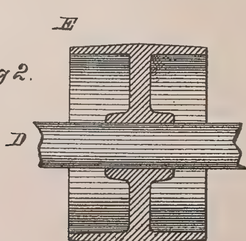


Fig 2.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 287,513, dated October 30, 1883.

Application filed June 29, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines, (Case No. 574,) of which the following is a specification.

In the operation of dynamo-electric machines by means of belts passing over pulleys on their armature-shafts difficulties or inconvenience is sometimes experienced from the fact that the pulley, having a considerable mass of magnetic material, is magnetically attracted by the field-magnet of the machine, and therefore the armature-shaft may be drawn toward the magnet, causing friction and heating at the bearing at the opposite end of the shaft.

The object of my invention is to obviate this difficulty; and to this end the invention consists in the use, in connection with the armature-shaft of a dynamo or magneto electric machine or electric motor of such construction that the pulley is sufficiently within the magnetic influence of the poles of the field-magnets to produce the objectionable result above specified, of a pulley of non-magnetic material. I prefer to employ brass for this purpose, though other non-magnetic metals, or suitable substances not metallic, may be used, if desired.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of a dynamo or magneto electric machine embodying said invention, and Fig. 2 a sectional view of the pulley used.

A is the field-magnet, B the armature, C the commutator, and D the armature-shaft, of the generator.

E is the pulley, by which the shaft is connected to a suitable source of power. Heretofore such pulleys, having been made of iron or steel, have been attracted toward the field-magnet A, and consequently the armature-shaft had a tendency to move toward the end *a* farthest from the pulley, so that friction and heating were produced at this point. I construct the pulley E of brass or other non-magnetic material, and hence it is not magnetically attracted, and this difficulty is obviated.

It is evident that the invention is readily applicable to electromotors in which a pulley is attached to the armature-shaft for connection with the driving machinery.

It is to be understood that all patentable features of the invention shown or described, but not claimed herein, are reserved for protection by other patents, and have been or will be embodied in other applications for patents.

What I claim is—

1. The combination, with a dynamo-electric machine or electric motor whose field-magnets are so arranged that the driving-pulley is within the attractive influence of their poles, of a pulley of non-magnetic material, whereby the attraction of the pulley toward the poles is prevented, substantially as set forth.

2. The combination, with a dynamo-electric machine or electric motor whose field-magnets are so arranged that the driving-pulley is within their attractive influence, of a brass pulley, whereby the attraction of the pulley toward the poles of the magnet is prevented, substantially as set forth.

This specification signed and witnessed this 25th day of June, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 287,514. Patented Oct. 30, 1883.

Fig. 1.

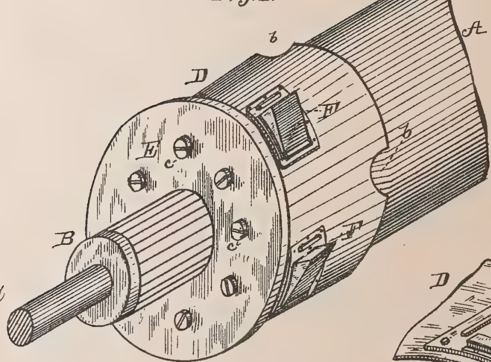


Fig. 5.

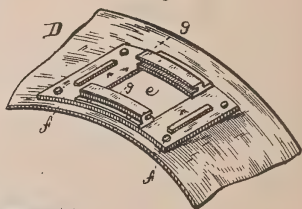


Fig. 6.

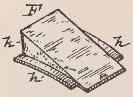


Fig. 2.

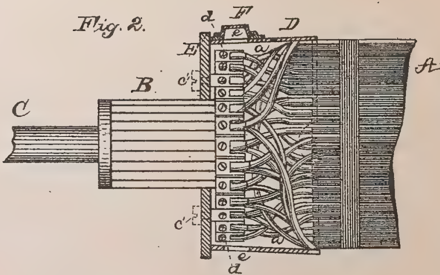


Fig. 3.

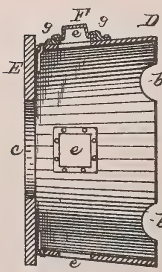
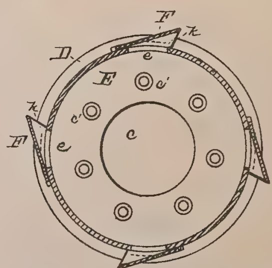


Fig. 4.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 287,514, dated October 30, 1883.

Application filed June 29, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines, (Case No. 582,) of which the following is a specification.

The object of this invention is to maintain a current of air upon the armature of a dynamo-electric machine, to prevent heating thereof, and especially to keep cool the connecting devices between the armature-coils and the commutator.

Said invention relates to the arrangement of a blower with relation to the armature of the machine, and also to the construction of a blower suitable for the purpose mentioned.

In carrying out my invention I employ a blower external to the armature, and mounted directly thereon. Such blower is placed directly over the connections between the armature and commutator, so as to inclose such connections, extending, however, over the end of the armature, so as to force air along the surface of said armature. The blower which I prefer to use consists of a cylinder, of wood or other insulating material, open at one end, and having an aperture at its other end of such size as to fit closely upon the commutator-cylinder. In the surface of said blower-cylinder are several openings, and over said openings are placed buckets, cups, or fans, so that when the cylinder is revolved air is caught by said buckets, cups, or fans and forced in directly upon the commutator-connections and out at the open end of the blower-cylinder. Said open end fits closely upon the armature-cylinder, but several notches or slots are formed in its edge, so that the air can escape through such notches to the surface of the armature. The buckets on the outside of the blower-cylinder are removable and reversible, so that they may be turned around to catch the air if the direction of revolution of the armature should at any time be reversed.

My invention is illustrated in the annexed drawings, in which Figure 1 is a perspective view of the end of an armature with the blower placed thereon; Fig. 2, an elevation of the end of the armature with the blower in longitudinal section; Fig. 3, a longitudinal section of the blower detached from the armature; Fig. 4, a cross-section of the blower, viewed from the armature end; Fig. 5, an enlarged view of a portion of the outside of the blower, showing an air-opening with the bucket removed; and Fig. 6, a view of the detached bucket.

A is the armature, B the commutator-cylinder, and C the armature-shaft, of a dynamo or magneto electric machine. The coils *a a* upon the armature are connected with the commutator-bars by suitable connecting devices, preferably as shown in other applications made by me.

D is the wooden shell or cylinder of the blower. Its open end rests closely upon the end of the armature, and is provided with notches *b*, which form openings through which the air escapes. The other end of the cylinder is the wooden plate E, having the aperture *c*, which fits upon the commutator-cylinder. The plate E is secured by means of screws *c′ c′*, which enter certain of the metallic connecting-pieces *d d*, some of these pieces being extended out toward the commutator for this purpose.

The sides of the blower cylinder or shell are provided with a suitable number of openings, *e*. Around such openings the plates *f* are attached, which are preferably of metal—such as brass—and on opposite sides of each of said openings are placed the grooved strips *g g*. The projecting edges *h h* of the bucket F are inserted in the grooves of the two strips *g g*, and the bucket is thus slid into and held in position over the opening *e*. It is evident that a bucket may be placed with its open end *k* in either direction, and that the buckets may be readily removed and reversed, according to the direction in which the machine is run.

When the armature is revolved, air is caught by the buckets and forced in through the openings *e*, directly upon the connections and out through the notches *b* upon the surface of the armature.

The blower, arranged as described, is especially adapted for cooling the connections between the armature and commutator of the machine, although it is efficient also for cooling the entire surface of the armature.

I do not claim herein the peculiar construction of the blower, *per se*, as I propose to make this the subject of a separate application for Letters Patent; and it is to be understood that

all patentable features of invention shown or described, but not claimed herein, are reserved for protection by other patents, and have been or will be embodied in other applications for patents.

What I claim is—

1. The combination, with a dynamo-electric machine, of an air-blower inclosing the commutator-connections of said machine, substantially as set forth.

2. The combination, with a dynamo-electric machine, of an air-blower mounted directly upon the armature of said machine and inclosing the commutator-connections, substantially as set forth.

3. The combination, with a dynamo-electric machine, of an air-blower inclosing the commutator-connections, and provided with outlets opening upon the surface of the armature, substantially as set forth.

4. The combination, with a dynamo-electric machine, of a blower consisting of a cylindrical shell having inlet-openings and external buckets, cups, or fans, and one or more outlets for blowing air upon the surface of the armature, substantially as set forth.

5. The combination, with a dynamo-electric machine, of a blower mounted upon the armature of said machine and inclosing the commutator-connections, having air-inlets in its sides and one or more openings for blowing air upon the surface of the armature, substantially as set forth.

6. The combination, with the armature of a dynamo-electric machine, of a blower having an open end fitting over the end of said armature, and provided with notches forming air-outlets, substantially as set forth.

7. The combination, with a dynamo-electric machine, of a blower formed of insulating material, and placed directly upon the commutator-cylinder and armature of the machine, substantially as set forth.

8. The combination, with a dynamo-electric machine, of a blower formed of insulating material, mounted directly upon the armature of said machine and secured to the conducting-pieces between the armature-coils and the commutator, substantially as set forth.

9. The combination, with a dynamo-electric machine, of a blower revolved from the armature-shaft of said machine, and provided with reversible buckets, cup, or fans, substantially as set forth.

10. The combination, with a dynamo-electric machine, of the blower shell or cylinder having its open end fitting over the end of the armature, and provided with notches forming air-outlets, and its other or closed end provided with an aperture fitting upon the commutator-cylinder, substantially as set forth.

This specification signed and witnessed this 25th day of June, 1883.

THOS. A. EDISON.

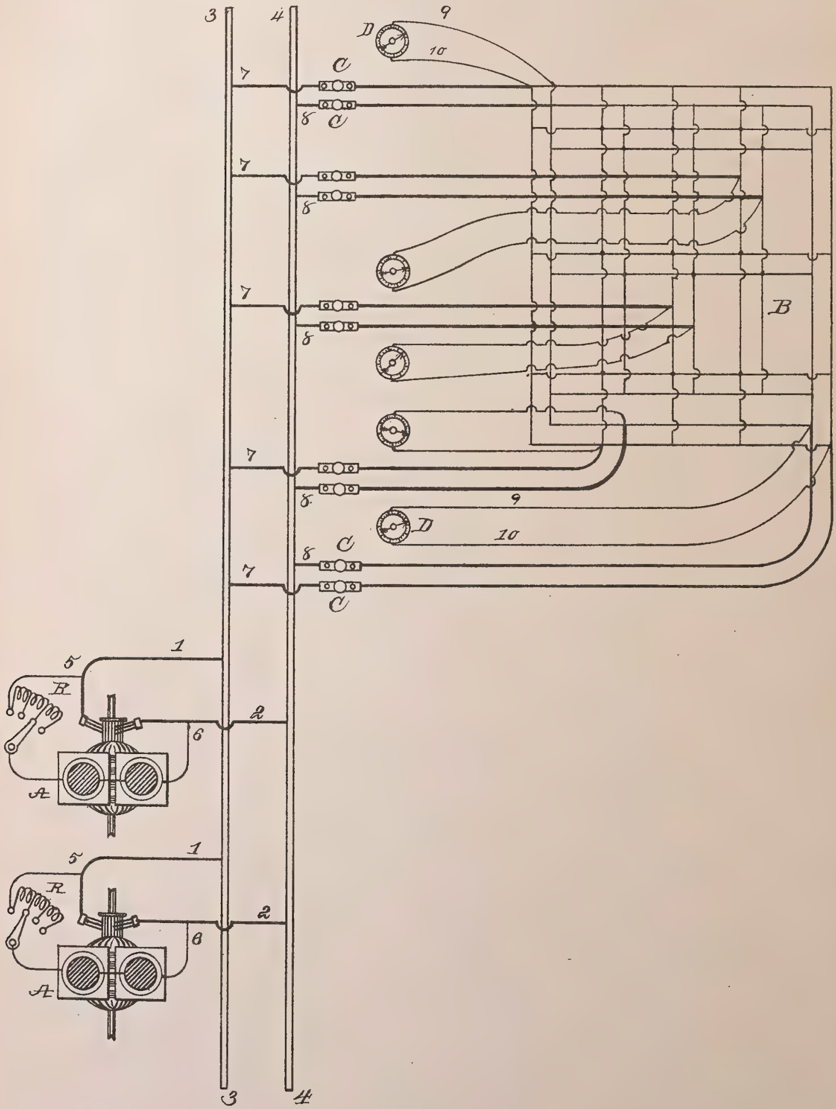
Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 287,515. Patented Oct. 30, 1883.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich. N. Dyer,

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 287,515, dated October 30, 1883.

Application filed June 29, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electrical Distribution, (Case No. 581,) of which the following is a specification.

In my system of electrical distribution the lamps or other translating devices are arranged in multiple arc in circuits connected with a net-work of intersecting main conductors, and feeding - conductors without translating devices, and upon which the principal part of the loss of energy in conductors is sustained, are connected to the net-work of main conductors at various points and extend to a central station, where the current for supplying the system is generated by machines, with each of which all the feeders are connected. Two kinds of regulation are required—one of the electromotive force of the generators, and one of the distribution of the current to various parts of the system. In my Patent No. 266,793 the latter kind of regulation is performed by throwing resistance into and out of the feeding-circuits; but I have discovered that this regulation can be efficiently performed by breaking and making the feeding-circuits. This method of regulation is set forth in my application No. 88,363, wherein is described and shown a circuit-controller for making and breaking one side of each feeding-circuit, and a method of regulation is set forth by the manipulation of such circuit-controllers.

The object of my present invention is to obtain by the making and breaking of feeding-circuits a much finer regulation with the same number of feeding-circuits than can be obtained by the means set out in said application No. 88,363, and my object is further to produce a simple and efficient connection between the feeders and the generators. The net-work of main conductors forms, it will be understood, the sides of a single circuit, the circuit being completed from one side of the net-work to the other through the translating devices, and hence the feeding-conductors extending to the central station are in fact all divisions of one circuit. Now, if one side only of the feeding-circuits is adapted to be made and broken, the other side of the feeding-circuits will always remain of the same conductivity, and all the regulation will be performed upon one side of such feeding-circuits. Now, I propose to provide each side of each feeding-circuit with a circuit-controller, and thus it will be seen not only will the chances for regulation be doubled with the same number of feeding-circuits, but a great number of variations can be made in the arrangement of the points at which the current will enter and leave the net-work of main conductors, and hence the regulation can be made quite a perfect one with a moderate number of feeding-circuits. At the central station all the generators are connected to a pair of large parallel conductors, which extend to that point in the building where the feeding-conductors are grouped together. There the conductors of the feeding-circuits are connected with the two conductors from the machines, each through a suitable circuit-controller. This manner of connecting the conductors is found very convenient in practice, the parallel conductors being preferably run along the wall of the room in which the generators are placed, past all the generators, while conductors extend from each generator to them. The feeding-conductors may be connected at any desired point. Means are provided for indicating at the central station the electro-motive force at the end of each feeding-circuit, where the feeding-conductors are connected with the net-work of main conductors. For this purpose a circuit is run back from the terminus of each feeding-circuit to the central station, and is there provided with an electro-dynamometer. The regulation described of the distribution of the current to various parts of the system is used in connection with a regulation of the electro-motive force of the generators. This latter regulation is preferably effected by throwing resistance into and out of the field-circuits of the machines.

The invention is illustrated diagrammatically in the accompanying drawing, forming a part hereof.

A A are dynamo or magneto electric machines, connected by conductors 1 2 to the large parallel conductors 3 4 common to all the machines. The field-circuits 5 6 of the machines are preferably multiple-arc circuits from the conductors supplied by the machines, and are provided with adjustable resistances R. The feeding-circuits 7 8 extend from the common

conductors 3 4, with which they are connected at different points lengthwise of such conductors 3 4, to different points in the net-work B of connected main conductors. Each feeding-conductor is provided within the central station with a circuit-controller, C, which may be of any suitable construction, it being shown, for convenience, as the ordinary hand-plug. Circuits 9 10 are run back to the central station from the terminals of the feeding-circuits, and are provided with the electro-dynamometer D.

Some features of invention which are described or shown herein are not claimed, for the reason that they are claimed in my applications Nos. 88,356 and 88,363, and it is to be understood that all patentable features of invention described or shown but not claimed herein are reserved for protection by other patents, and have been or will be embraced in other applications for patents.

What I claim is—

1. The method of regulating the supply of current in a system of electrical distribution, comprising a system of intersecting and properly-connected main conductors, and feeding-circuits connecting such main conductors with the source of supply, consisting in making and breaking in the desired order both sides of the requisite number of said feeding-circuits, substantially as set forth.

2. In a system of electrical distribution, the combination of the intersecting and properly-connected main conductors and the feeding-circuits, the latter having circuit-controllers in both sides, substantially as set forth.

3. In a system of electrical distribution of the character described, the combination of the feeding-circuits having circuit-controllers in both sides thereof, and means for indicating the electrical condition at the termini of said feeding-circuits, substantially as set forth.

4. In a system of electrical distribution of the character described, the combination, with the feeding-circuits provided with circuit-controllers on both sides, of the generators, and means for regulating the electro-motive force of such generators, substantially as set forth.

5. In a system of electrical distribution, the combination, with two or more generators, of a pair of common parallel conductors, to which the generators are connected, and the feeding-conductors connected with such common conductors at different points lengthwise thereof, substantially as set forth.

This specification signed and witnessed this 25th day of June, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

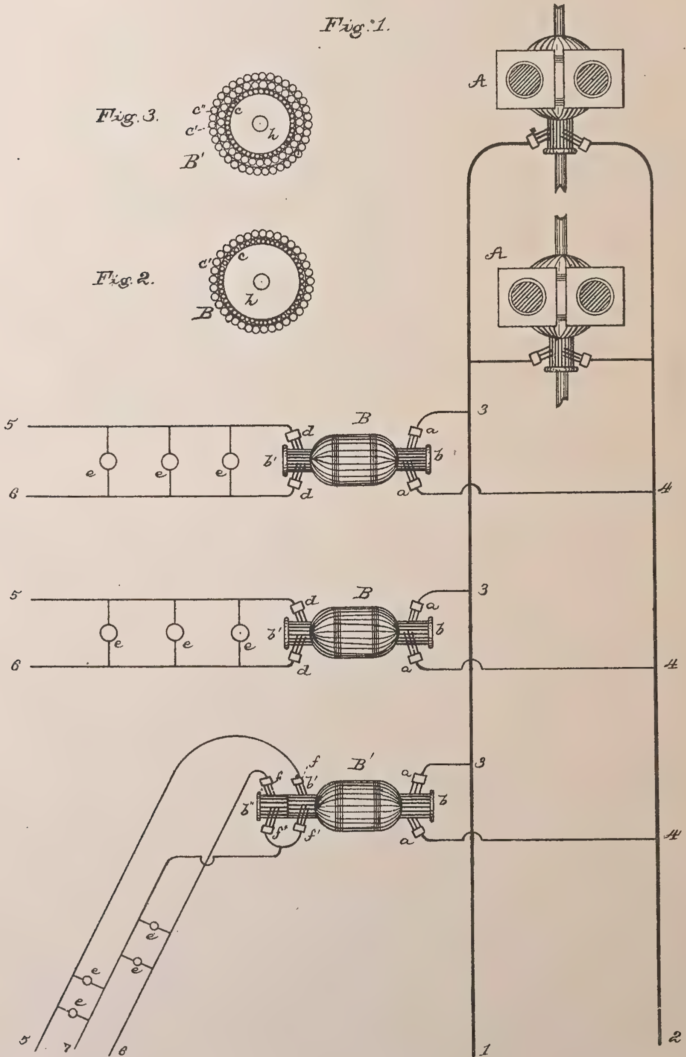
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

SYSTEM OF ELECTRIC DISTRIBUTION.

No. 287,516. Patented Oct. 30, 1883.



ATTEST:

Edw. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Richd. N. Dyer,
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SYSTEM OF ELECTRIC DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 287,516, dated October 30, 1883.

Application filed May 14, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Systems of Electrical Distribution, (Case No. 564,) of which the following is a specification.

The object of this invention is to provide a system of electrical distribution wherein currents can be economically transmitted from a distant source of energy—such as a water-power—to the town, village, or other locality which is to be supplied, and there distributed from different independent central stations, situated at convenient points, to the various parts of such locality.

Generally speaking, such system consists of a sufficient number of electrical generators of high electro-motive force situated at the source of power, main conductors of small area extending from such generators to the locality to be supplied, devices connected with such conductors in multiple arc for reducing the tension of the current, each device or set of devices being placed at a distributing-station, a circuit or circuits extending from each of such distributing-stations for conveying the low-tension currents, and translating devices—such as electric lamps or electromotors—connected with such low-tension circuits.

The device which I prefer to use for accomplishing the reduction of tension consists of a field-magnet and an armature-core, on which are wound two sets of coils—one of fine wire, connected with a commutator whose brushes are placed in the multiple-arc circuit from the main conductors, the other of coarser wire, connected with a commutator from whose brushes the circuit or circuits extend, on which the translating devices are arranged, preferably, in multiple arc. The field-magnets may be energized by a constant current in any suitable manner.

Where it is desired to employ the compensating system set forth in my Patent No. 274,290, I wind the core with three sets of coils, one acting as a motor-coil and the other two as generator-coils. Preferably two commutators are provided for these generator-coils, one set of coils being connected to each commutator. The main conductors of the distributing-circuit are each connected to a brush on one of the commutator-cylinders, while the compensating-conductor is connected with two brushes—one on each cylinder—and the translating devices are connected each between a main conductor and the compensating-conductor, as usual.

My invention is illustrated in the annexed drawings, in which—

Figure 1 is a diagram of the system, the field-magnets being omitted from the combined generators and motors; Fig. 2, a sectional view of the armature with two windings, and Fig. 3 a section of the armature with three windings.

A A represent generators of high electro-motive force, connected in multiple arc to main conductors 1 2; or two or more generators may be connected in series to produce the electro-motive force required. At a point where it is desired to place stations or centers of distribution a multiple-arc circuit, 3 4, is connected with the main conductors 1 2. The conductors of such multiple-arc circuits extend to brushes *a a*, bearing on a commutator-cylinder, *b*, of an armature, B or B′.

The armatures B each consist of a core, *h*, on which are wound two sets of coils—one coil, *c*, of fine wire, connected with commutator *b*, the other, *c′*, of coarser wire, connected with commutator *b′*. The coils *c* are of such high resistance that the main conductors are not short-circuited through them. A common field-magnet is employed for both sets of coils, as will be readily understood, and, as explained in my Patent No. 265,786, the transmission of current through the coils *c* and through the field-magnet causes the revolution of the armature, and the coils *c′* thus cut the lines of force and cause the generation of a continuous current of such tension as is provided for by the winding of the coils.

Commutator-brushes *d d* rest upon the cylinder *b′*, and conductors 5 6 extend from such commutator-brushes, translating devices *e e* being placed in multiple-arc circuits across such conductors, and being thus supplied with currents of the proper tension.

The armature B′ has three sets of coils, one, *c*, forming the motor-coils, the others, *c′ c″*, being the generating-coils. The coils *c′* are connected to the commutator-cylinder *b′*, and the coils *c″* to the cylinder *b″*. The conductors

5 6 extend from the brushes *f f*, which bear one on each of these cylinders, and the compensating-conductor 7 is connected with the two opposite brushes, *f′ f′*. The translating devices *e e* are connected between the compensating-conductor and the main conductors, as shown.

It is evident that a single commutator-cylinder could be employed, instead of the two commutators *b′ b″*, with the conductors 5 6 connected to main brushes, bearing on said commutator, and the compensating-conductor 7 connected to an extra brush placed between them.

It is evident that the coils *c′ c″* in the triple-wound machine could be of the same size wire as the coils *c*, for the use of two sets of such coils will accomplish a certain reduction of tension, and in a compensating system the currents used are of higher tension than in the ordinary system.

In the system described in my Patent No. 265,786, above referred to, several combined generators and motors are shown, the motor-coils being placed in series in one of the main conductors and translation-circuits leading from the generating-coils. In this case the devices are not independent, and therefore the arrangement is inapplicable to my present purpose of providing independent distributing-stations, at which apparatus is placed for reducing the tension of the current.

It will be seen that by my present arrangement the tension-reducing devices, being placed in multiple arc, are entirely independent of each other, and either can be thrown out of use without affecting the others.

What I claim is—

1. In a system of electrical distribution, the combination of a source of electricity, main conductors extending therefrom, two or more combined generators and motors having their motor-coils connected in multiple arc with said main conductors, distributing-circuits extending from their generating-coils, and translating devices connected with such distributing-circuits, substantially as set forth.

2. The combination, with main conductors, of a tension-reducing device connected therewith, a distributing-circuit and a compensating-conductor extending from said tension-reducing device, and translating devices connected between the main conductors of said distributing-circuit and said compensating-conductor, substantially as set forth.

3. The combination, with a core, of a motor-coil connected with main conductors, two generator-coils, each connected with a commutator-cylinder, main distributing-conductors connected each with a brush bearing on one commutator, and a compensating-conductor connected with both the opposite brushes, substantially as set forth.

This specification signed and witnessed this 8th day of May, 1883.

THOS. A. EDISON.

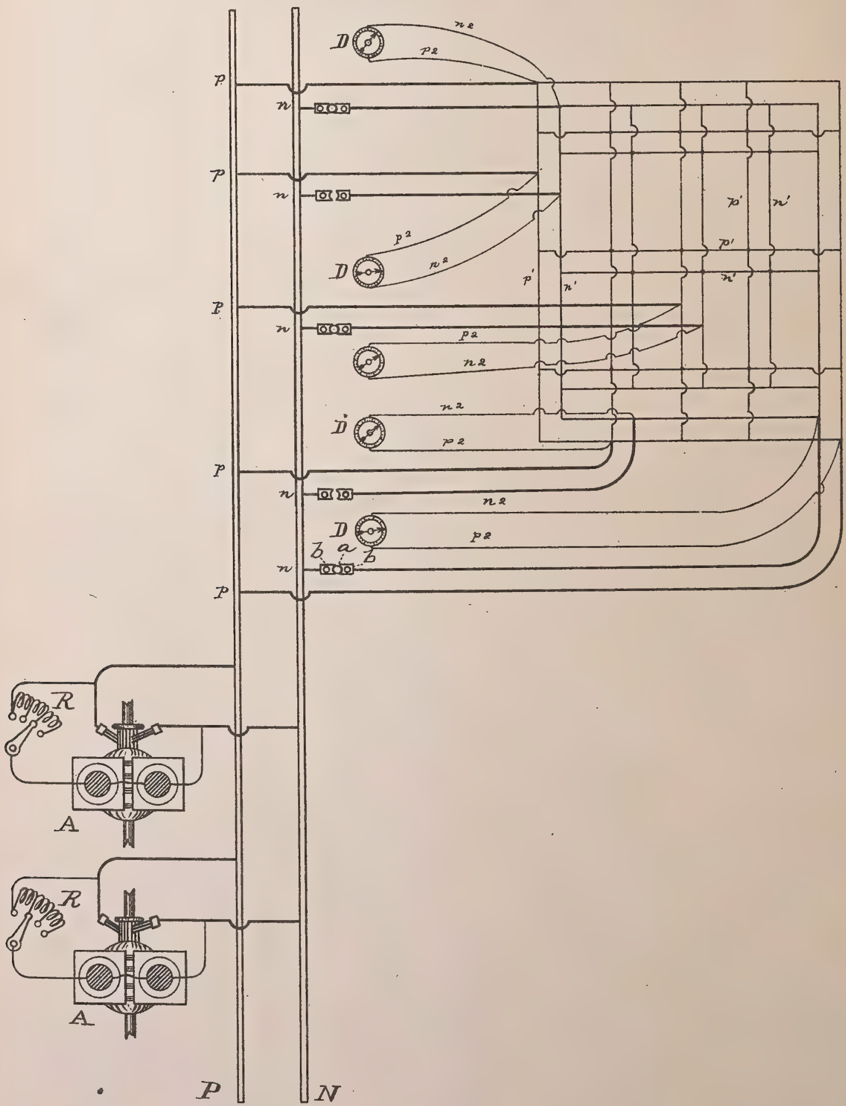
Witnesses:
WM. H. MEADOWCROFT,
H. W. SEELY.

(No Model.)

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 287,517. Patented Oct. 30, 1883.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd N. Dyer,

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 287,517, dated October 30, 1883.

Application filed March 16, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Distribution Systems, (Case No. 553,) of which the following is a specification.

The object of this invention is to regulate the current supplied to the translating devices of a system of electrical distribution employing feeding-circuits, so as to maintain a constant electro-motive force in the system and furnish a constant current to each translating device in circuit. Such a system consists of one or more generators situated at a central station, from which feeding-circuits containing no translating devices run to different parts of the district supplied, where they are connected to the positive and negative main conductors, these being arranged, as usual in my system, with all the intersecting positive conductors connected together, and likewise all the negative. The translating devices of the system are arranged in multiple arc upon circuits leading from these main conductors. Each feeding-circuit exerts a certain influence over the entire district, such influence being of course greatest at that part of the district contiguous to its terminals, but extending, to some extent at least, to the portions remote therefrom. I have found, therefore, that the current can be regulated and kept constant in all parts of the district simply by connecting and disconnecting the feeders. When the number of translating devices in a certain part of the district decreases to a great extent, the feeder running to this point is disconnected, and the few translating devices still in circuit will be supplied by the remaining feeders; or, when the number of translating devices in a certain part increases, a feeder terminating near such part is connected. Means are provided at the central station for indicating the electro-motive force at the terminals of the feeders. This regulation is used in connection with the regulation of the generators by the adjustable resistances in their field-circuits, or by other suitable means, which regulate for changes in the entire number of translating devices in circuit.

The accompanying drawing is a diagram of a system of electrical distribution provided with means for carrying out my invention.

A A are dynamo-electric machines, each having its field and its armature connected in multiple arc with the conductors P N, which are situated within the central station. The feeding-circuits p n are connected in multiple arc with these conductors, and extend to various points of the district, where they are connected to the intersecting positive and negative main conductors p' n', which supply the translating devices. Each feeding-circuit is provided with a suitable circuit-controller. A convenient form is a metal plug, a, inserted between two metal plates, b b, to close the circuit, and withdrawn to break the circuit. If the number of translating devices in any part of the district increases to such an extent that the current supplied is insufficient for them, the feeding-circuits leading nearest to such point would be plugged in, and the feeding-circuits would be broken, as less current is required at the points contiguous to their terminals. To indicate the electrical condition at the terminals of the feeders, the auxiliary circuits p^2 n^2, of small wire, are run back to the central station, where each is connected with an electro-dynamometer, D, and the regulation is performed in accordance with the indications of these instruments.

The adjustable resistances R R in the field-circuits of the generators are used to increase and decrease the currents supplied through all the feeders to the entire district.

It is evident that this method of regulation could be readily applied to my "compensating" system in cases where feeding-circuits are employed in such a system.

What I claim is—

1. The method of regulating the supply of current in a system of electrical distribution, comprising a system of positive and negative main conductors and feeding-circuits, connecting the source of supply with said main conductors, consisting in breaking and closing the feeding-circuits, according to the cur-

rent required in the parts of the system contiguous to their terminals, substantially as set forth.

2. In a system of electrical distribution, the combination of the intersecting and properly-connected positive and negative main conductors, and the feeding-circuits extending from the source of supply to said main conductors, each of said feeding-circuits being provided with a circuit-breaker, substantially as set forth.

3. In a system of electrical distribution of the character described, the combination, with the feeding-circuits, each provided with a circuit-controller, of means for regulating the current generated at the source of supply, substantially as set forth.

4. In a system of electrical distribution of the character described, the combination, with the feeding-circuits, each provided with a circuit-controller, and means for constantly indicating the electrical condition at the terminals of said feeding-circuits, of means for regulating the current generated at the source of supply, substantially as set forth.

This specification signed and witnessed this 14th day of March, 1883.

THOS. A. EDISON.

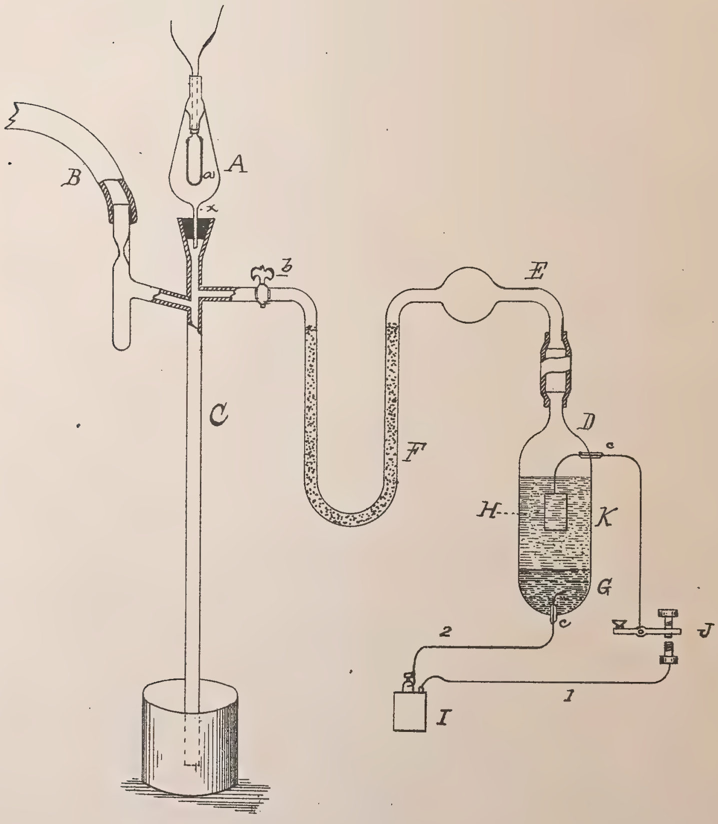
Witnesses:
WM. H. MEADOWCROFT,
H. W. SEELY.

(No Model.)

T. A. EDISON.

METHOD OF MANUFACTURING INCANDESCING ELECTRIC LAMPS.

No. 287,518. Patented Oct. 30, 1883.



WITNESSES:

Edw. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich^d N. Dyer

Atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

METHOD OF MANUFACTURING INCANDESCING ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 287,518, dated October 30, 1883.

Application filed September 13, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescing Electric Lamps, (Case No. 481,) of which the following is a specification.

The object of my invention is to render the carbon filaments which form incandescing-conductors of electric lamps more durable in use. I accomplish this by first exhausting the lamp-globe as completely as possible by means of a Sprengel vacuum-pump, and then filling the globe with pure hydrogen, free from moisture, to an atmospheric pressure. I then heat the carbon filament by an electric current to a much higher temperature than that to which it is to be subjected in use. It being subjected to atmospheric pressure during such heating, the carbon becomes more compact. The hydrogen is then exhausted, and the carbon is again heated to high incandescence, to remove any of the gas which may remain within its pores, after which the lamp is sealed off from the pump.

Instead of filling the globe with hydrogen, I may employ any other inert gas—such as chlorine gas; but hydrogen is preferable.

In carrying out my invention I may employ the apparatus illustrated in the drawing.

A represents the inclosing-globe of an incandescing electric lamp, and *a* the carbon filament. The lamp is attached to a Sprengel pump, of which B is the supply-tube, and C the fall-tube.

D is a glass vessel, connected by a tube, E, with the vacuum-pump. A portion of the tube is filled with phosphoric anhydride, F, or other similar drying agent, and the tube is provided with a stop-cock, *b*.

In the bottom of the vessel D is placed an amalgam of mercury and zinc, G, and above this is placed a quantity of sulphuric acid and water, K, in which is immersed a plate, H, of platinum.

From a battery, I, wires 1 2 run, respectively, to the platinum plate H and to the amalgam G. Such wires each have a small portion, at *c*, of platinum sealed into glass, the latter being sealed into the glass of the vessel D. A key, J, is provided for opening and closing the battery-circuit.

The operation is as follows: The air is first exhausted from the lamp-globe and from the vessel D by the Sprengel pump, the stop-cock *b* and key J being open. The operation of the pump is then stopped and the circuit 1 2 closed. The liquid K in the vessel D is decomposed by the current, and the oxygen combines with the zinc of the amalgam, to form an oxide of zinc, which combines with the sulphuric acid, to form sulphate of zinc. Pure hydrogen is therefore given off, which enters the lamp-globe, a sufficient amount being allowed to enter to produce an atmospheric pressure therein, after which the stop-cock *b* is closed and circuit 1 2 is opened, so that no more hydrogen can enter the pump. The carbon filament is then electrically heated through the wires 3 4 to a higher incandescence than that at which it is intended to be used. The hydrogen is then pumped out, after which the carbon is again electrically heated, the pump still continuing in operation, the residual and occluded gases being thus almost completely removed. The lamp is sealed off at *x*, and is then ready for use.

Where another gas than hydrogen is used, suitable apparatus for generating the same would be similarly connected with the lamp and pump.

What I claim is—

1. The method of manufacturing incandescing electric lamps, which consists in charging the globe of a lamp with pure hydrogen or equivalent inert gas, next heating the conductor within said globe to incandescence by an electric current, removing said gas from the globe, and finally sealing off said globe, substantially as set forth.

2. The method of treating the carbon filaments of incandescing electric lamps, consisting in heating them to a higher incandescence than that at which they are intended to be used in an atmosphere of pure hydrogen or equivalent inert gas, substantially as set forth.

3. The method of treating the carbon filaments of an incandescing electric lamp, consisting in first exhausting the air from the globe inclosing the filament, and replacing it

by pure hydrogen or equivalent inert gas, heating the conductor to incandescence by an electric current, removing the hydrogen from the globe, and again heating the filament, the operation of the exhausting apparatus being continued during this latter heating, substantially as set forth.

This specification signed and witnessed this 25th day of August, 1882.

THOS. A. EDISON.

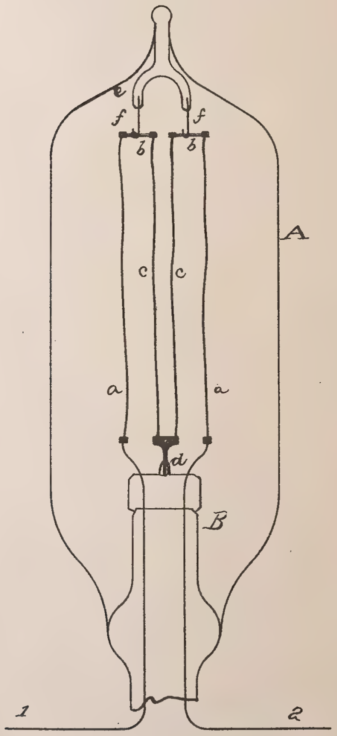
Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

INCANDESCING ELECTRIC LAMP.

No. 287,519. Patented Oct. 30, 1883.



ATTEST:
E. C. Rowland
W. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer,
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

INCANDESCING ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 287,519, dated October 30, 1883.

Application filed December 8, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Electric Lamps, (Case No. 524,) of which the following is a specification.

The object of my invention is to provide for the expansion and contraction caused by the heating and cooling of the straight carbon filaments of incandescing electric lamps, in order that such expansion and contraction may not injure the filament, while at the same time the filament is held upright. To accomplish this I support the filament loosely from the top of the inclosing-globe in which it is placed, so that it will sag sufficiently to compensate for the contraction and expansion.

My invention is illustrated in the annexed drawing, which is a view in elevation of a lamp embodying said invention.

A is the glass inclosing-globe, and B is the inner stem or wire support sealed within the globe. The leading-in wires 1 2 pass through the stem B, and to their ends are attached the ends of the straight flexible carbon filaments *a a*. The other end of each filament *a* is connected by a wire, *b*, with the upper end of a similar straight filament, *c*, and the filaments *c c* are united, preferably, by electroplating, and supported from the glass of the inner stem, at *d*. A glass tube, *e*, is sealed in the glass at the top of globe A, and two wires, *f f*, terminating in hooks, extend down from said tube. Each hook supports one side of the incandescing conductor; but the wires *f f* are of such length that the filaments are held loosely, and allowed to slacken or bend when they expand under heat, and to straighten out again in cooling.

It is evident that the incandescing conductor might consist of only two straight filaments. If two were used, their upper ends would be connected by a single wire, and a single hook would depend from above to grasp the wire.

It is to be understood that all patentable features of invention described or shown but not claimed herein are reserved for protection by other patents, and have been or will be embodied in other applications for patents.

What I claim is—

1. The combination, with the incandescing conductor of an electric lamp, of one or more supports therefor, in addition to the leading-in wires of the lamp, said support or supports depending from the top of the lamp and being loosely attached to said conductor, substantially as set forth.

2. In an incandescing electric lamp, the combination of two or more straight flexible carbon filaments connected by wires at their upper ends with one or more supports loosely attached to said wires, substantially as set forth.

3. In an incandescing electric lamp, the combination, with two or more straight flexible carbon filaments united at their upper ends by wires, of wires attached to the glass of the lamp, and terminating in hooks which grasp said uniting-wires loosely, substantially as set forth.

This specification signed and witnessed this 28th day of November, 1882.

THOS. A. EDISON.

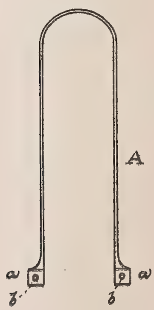
Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

INCANDESCING CONDUCTOR FOR ELECTRIC LAMPS.

No. 287,520. Patented Oct. 30, 1883.



ATTEST:
E. C. Rowland,
[illegible]

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer,
Atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

INCANDESCING CONDUCTOR FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 287,520, dated October 30, 1883.

Application filed November 9, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Conductors for Electric Lamps, (Case No. 511,) of which the following is a specification.

In my application No. 506 (Serial No. 76,378) are set forth various ways in which the incandescing conductors of electric lamps may be removably attached to the leading-in wires.

The object of my present invention is to so form the incandescing filament that such removable connections may be readily made, and be secure and durable and of good electrical conductivity. To do this I form small holes in the enlarged ends of a filament, and then electroplate such ends, preferably with copper, in such manner that the insides of the holes will be plated. By this means the strength of the ends is increased, the metal covering preventing the carbon from splitting when the hooks or other connecting devices attached to the ends of the leading-in wires are placed in the holes. Where screw-clamps attached to the leading-in wires are used, the screws would be passed through the holes, the copper giving mechanical strength and electrical conductivity to the connection.

In the accompanying drawing, forming a part hereof, a carbon filament embodying the invention is shown in elevation.

A is the flexible carbon filament, having enlarged ends *a a*, each provided with an aperture, *b*, such ends and the interior walls of such apertures being covered with a coating of electro-deposited metal. The apertures *b* may be formed in any suitable manner either before or after carbonization.

I do not claim herein the invention of providing a carbon filament with plated ends or enlarged plated ends, since the same is covered by my application No. 23,810; and it is to be understood that all patentable features of invention described or shown but not claimed herein are reserved for protection by other patents, and have been or will be included in other applications for patents.

What I claim is—

The incandescing conductor of an electric lamp, having apertures in its enlarged ends, such ends and the interiors of such apertures being electroplated, substantially as and for the purpose set forth.

This specification signed and witnessed this 3d day of November, 1882.

THOMAS A. EDISON.

Witnesses:

H. W. SEELY,

EDWARD H. PYATT.

(No Model.) 2 Sheets—Sheet 1.

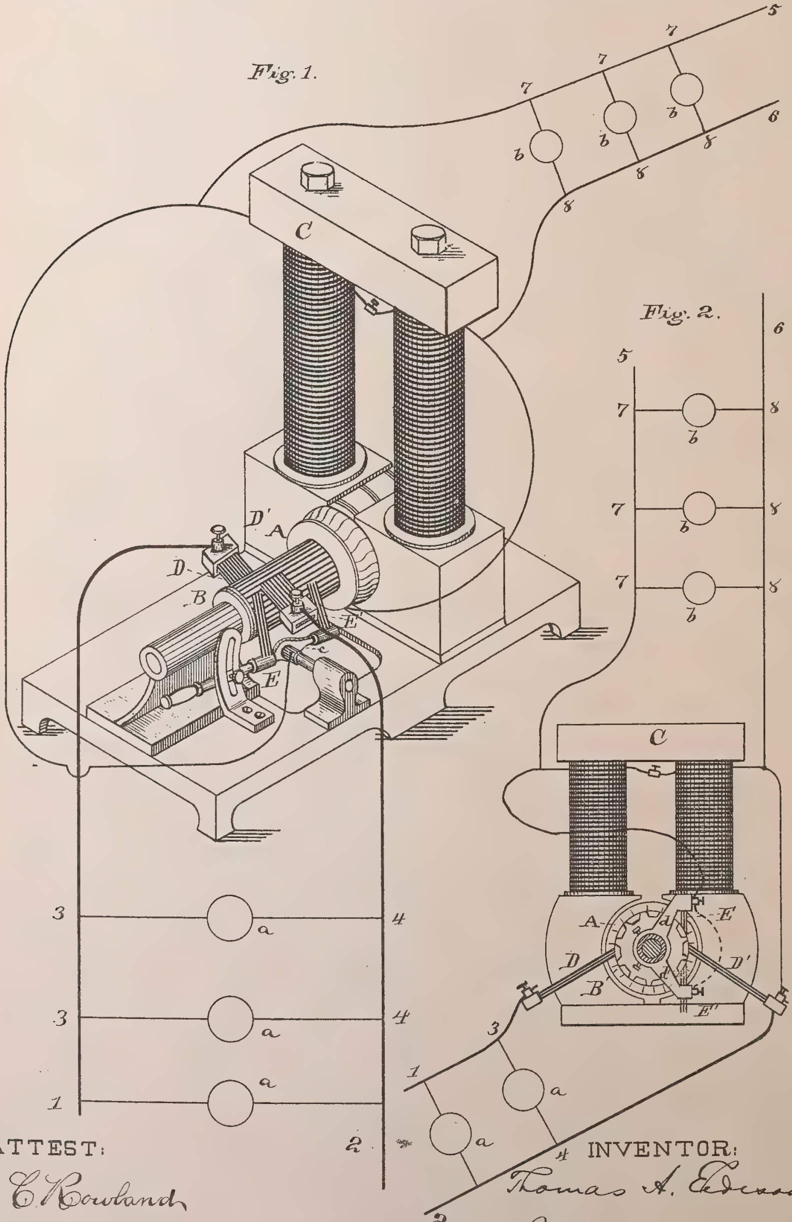
T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 287,521. Patented Oct. 30, 1883.

Fig. 1.

Fig. 2.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,

Atty.

(No Model.) 2 Sheets—Sheet 2.

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 287,521. Patented Oct. 30, 1883.

Fig. 3.

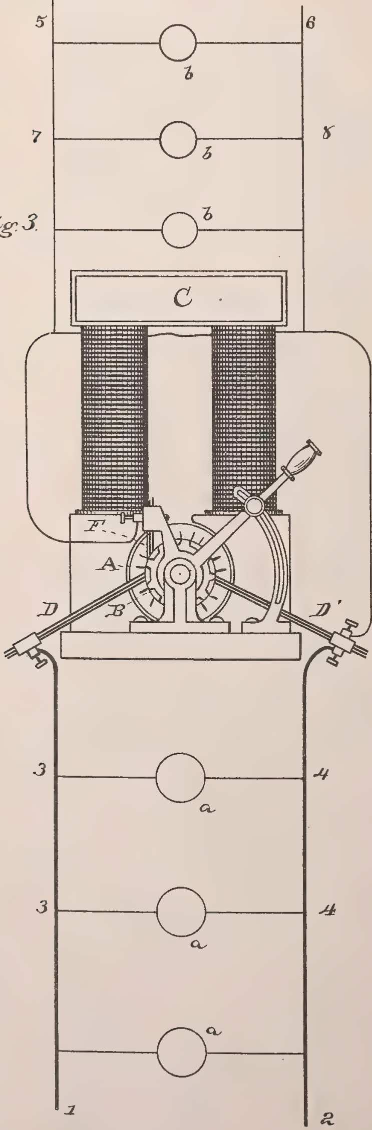
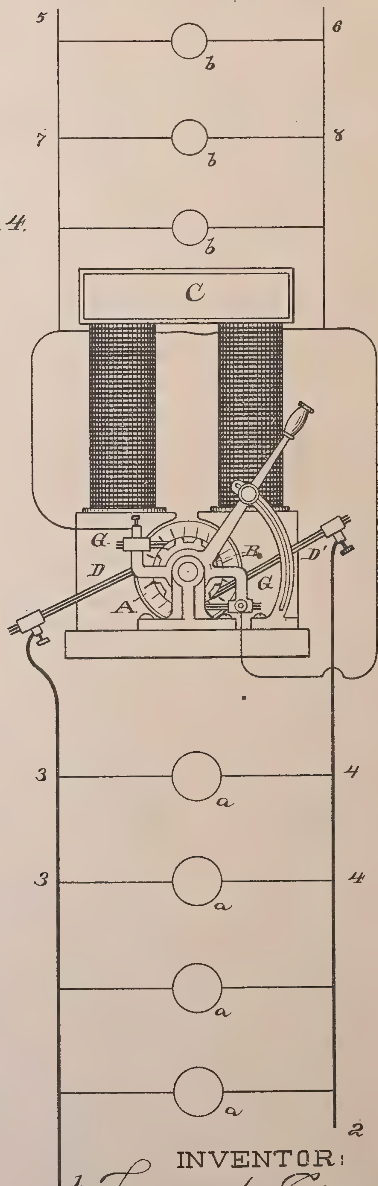


Fig. 4.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Rich^{d}. N. Dyer,
Att'y.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 287,521, dated October 30, 1883.

Application filed March 16, 1883. (No model.) Patented in England August 5, 1882, No. 3,756, and in France October 24, 1882, No. 151,725.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 549,) of which the following is a specification.

The object I have in view is to produce a method and means for deriving from a dynamo or magneto electric machine two or more independent circuits in which there will be a different electro-motive force or pressure, such circuits being adapted for independent regulation. The extra circuit (or circuits) will have a lower electro-motive force than the main circuit, and is designed more especially for use in energizing the field-of-force magnet of the machine, or for operating translating devices, of which incandescing electric lamps form the best example, placed in multiple-arc circuits, and requiring a current of lower tension than the lamps or other translating devices in the main circuit; or this extra circuit may have both the magnet-coils and the lamps connected therewith in multiple arc. The object is accomplished by arranging to bear upon the commutator-cylinder, on each side of one of the main commutator-brushes, a secondary brush, which is mounted so as to be capable of adjustment toward or away from the main brush, independent of or together with its fellow on the other side of the main brush. These two secondary brushes are connected together electrically, and from them is led one part of the secondary circuit, the other part being connected with the main brush on that side of the commutator-cylinder. The farther apart the secondary brushes are placed on opposite sides of the main brush the greater will be the tension of the current in the extra circuit, and hence the tension can be readily regulated by varying the position of such brushes with reference to the main brush. The tension of the current in the main circuit can be independently regulated by shifting the main brushes, or in any other suitable well-known manner. The connection of the secondary brushes together electrically does not short-circuit any of the coils of the armature, since currents are generated in the same circumferential direction on both sides of the armature. It is evident that in this manner two extra circuits could be derived from the same machine, instead of one, a set of secondary brushes being arranged to form a circuit with each main commutator-brush. In that case it will be seen that the extra circuits themselves may be regulated independently of each other or together, and may have currents of the same or different tension. It will also be understood that one secondary brush, instead of two, could be used in connection with a main brush to form each extra circuit, which secondary brush would be mounted for adjustment to and from the main brush forming the other pole of the extra circuit, and in this manner almost any desired number of extra circuits could be derived from one machine, the tension of the current in each depending upon the distance of the secondary brush from the main brush with which it is connected. It is also evident that an extra circuit could be formed by placing two secondary brushes on opposite sides of the commutator-cylinder at points between the main brushes, the secondary brushes forming the poles for the extra circuit, and the tension of the current in the extra circuit being dependent upon the position of these brushes with relation to the line of neutralized generation.

It will be understood that the armature of the machine is of the Pacinotti or Siemens type, being provided with a continuously-wound bobbin connected at intervals with the parallel bars of a commutator, and also that the currents of different tension are derived from this continuous bobbin, all the brushes resting upon the single commutator-cylinder.

The foregoing will be better understood by reference to the drawings, in which—

Figure 1 is a view, partly diagrammatic, illustrating the invention, and showing the form first described, with the secondary brushes mounted for simultaneous adjustment; Fig. 2, a view of the same arrangement when the secondary brushes are independently adjustable, and Figs. 3 and 4 views of other arrangements for accomplishing the same object.

A is the armature, B the commutator-cylinder, and C the field-of-force magnet, of the machine.

D D′ are the main commutator-brushes, which are mounted so as to be adjustable upon the commutator-cylinder. From these brushes run the main conductors 1 2, in multiple-arc or derived circuits 3 4, from which are the lamps or other translating devices *a*.

The secondary commutator-brushes E E′, Figs. 1 and 2, bear on the commutator-cylinder on opposite sides of the main brush D′. From the secondary brushes E E′ and the main brush D′ runs the extra circuit 5 6. The coils of magnet C and lamps or other translating devices *b* are in multiple-arc or derived circuits 7 8 from the conductors 5 6. These translating devices do not require a current of as high a tension as that required by the translating devices *a*.

In Fig. 1 the secondary brushes E E′ are shown as carried by a pivoted arm, *c*, so that they can be adjusted simultaneously in opposite directions toward and away from the main brush D′. In Fig. 2 they are carried by separate and independently-adjustable arms *d d′*.

In Fig. 3 a single secondary brush, F, is shown as used to form one pole for the extra circuit 5 6, the other pole being formed by one of the main brushes.

In Fig. 4 the secondary brushes G G are mounted to bear on opposite sides of the commutator-cylinder at points between the main brushes, and the conductors of the extra circuit are connected only with the secondary brushes.

I do not claim herein the broad idea of deriving two or more circuits of different tension from the same commutator connected with a continuously-wound bobbin, such circuits being independently regulated; neither do I claim herein the use of two or more auxiliary brushes adjustable independently of the main brushes, the circuit from said auxiliary brushes including the field-magnet coils of the machine, as these inventions form the subject of another application for Letters Patent, of which this is a division; but

What I do claim is—

1. The combination, with a dynamo or magneto electric machine having a continuously-wound bobbin and a single commutator, of main commutator-brushes and one or more auxiliary brushes bearing on said commutator, circuits having currents of different tension connected with said brushes, and translating devices arranged in mutiple arc in each of said circuits, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine having a continuously-wound bobbin and a single commutator, of main commutator-brushes and one or more auxiliary brushes bearing on said commutator, circuits having currents of different tension connected with said brushes, and incandescing electric lamps arranged in multiple arc in each of said circuits, substantially as set forth.

This specification signed and witnessed this 17th day of February, 1883.

THOS. A. EDISON.

Witnesses:
WM. H. MEADOWCROFT,
H. W. SEELY.

(No Model.)

T. A. EDISON.

MOLDS FOR CARBONIZING.

No. 287,522. Patented Oct. 30, 1883.

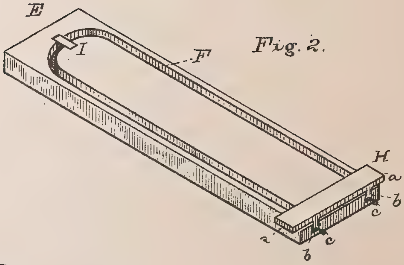


Fig. 2.

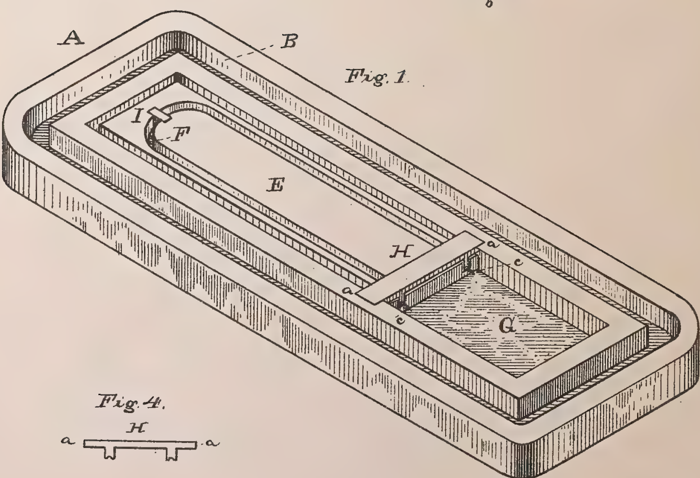
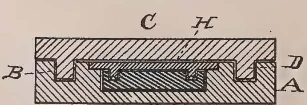


Fig. 1.

Fig. 4.

Fig. 3.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

MOLD FOR CARBONIZING.

SPECIFICATION forming part of Letters Patent No. 287,522, dated October 30, 1883.

Application filed March 16, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Molds for Carbonizing, (Case No. 542,) of which the following is a specification.

My invention relates to molds for carbonizing the filaments which form, after carbonization, the incandescing conductors of electric lamps, my object being to keep the filament under strain during carbonization, while at the same time allowing contraction, the filament being so held and the strain being applied in such manner that the most delicate filaments will not be fractured or injured.

This invention is especially intended to be applied to the carbonization of very fine filaments, a number of which are to be twisted or braided together to form a single conductor.

Heretofore in molds of this character the filament has usually been placed in a chamber with movable blocks or weights set upon its ends, and its center held by either a fixed or movable block, so that either its limbs alone or its limbs and center were allowed to contract, or else one or both ends would be fixed and a movable weight placed in contact with the center, which weight would be drawn up as the filament contracted. These molds were not provided with covers; but a number of them were set one on top of another in a carbonizing-chamber. The disadvantages of these plans, where very delicate filaments are employed, are that the friction of the weights set on the ends of the filament would tend to injure such ends, and where a weight was placed in the center the filament would sometimes slip under such weight, in which case it would probably be broken; also, in both cases, the rubbing of the filament upon the bottom and sides of the mold with which it was in contact, as it contracted, would be injurious, and some parts of the filament being out of contact with the mold, the filament would be unequally heated. In addition, as no cover was provided for the mold, air would be admitted thereto, tending to oxidize the filament. By my present invention I overcome these defects by so constructing a mold that the filament, while allowed to contract and kept under constant strain, will be always in the same position relative to the parts of the mold in contact with it, so that it cannot rub against such parts, the strain is always even and constant upon every part of the filament, and every part is always in contact with the mold; and, in addition, the mold is so constructed that access of oxygen to the filament is as nearly as possible prevented.

In carrying out my invention the mold is made in two separate parts—an outer inclosing-chamber made air-tight, as nearly as possible, and a removable forming-plate, in which the filament is placed, which plate is set in the outer chamber, the ends of the filament being secured outside of the forming-plate. The forming-plate is preferably an oblong plate or block provided with a groove of the shape and length of the filament before carbonization, and the outer inclosing-chamber has a space in its center, into which said plate or block is set, such space being longer than said plate or block. The walls of said outer chamber should be of considerable thickness, and are preferably provided with a groove extending entirely around the top of said walls. Attached to the outer portion, and extending across the inner space, is a "bridge," of suitable material, having two downward projections, which enter the two sides of the grooves on the forming-plate. Each of said projections has an aperture in its lower end, through which apertures extend the ends of the filament. A closely-fitting cover is provided, having a flange extending around its lower side, which flange enters the groove in the top of the outer chamber of the mold. Preferably one or more strips are placed across the top of the groove in which the filament is laid, to prevent the filament from leaving such groove. All the parts are made of carbon, nickel, or other material capable of withstanding high temperatures.

My invention is illustrated in the annexed drawings, in which Figure 1 is a perspective view of the entire mold; Fig. 2, a similar view of the interior block or plate which holds the

filament; Fig. 3, a cross-section of the entire mold, and Fig. 4 an elevation of the bridge.

A is the outer chamber, provided with a groove, B, and C is the cover, having a flange or rib, D, which enters the groove B.

E is the inner plate or block, having a groove, F, for containing the filament. The block E is set into the space G, which is, as shown, considerably larger than said block E.

H is the bridge, having its ends *a a* set into slots or notches formed in A. The bridge H has two downward projections, *b b*, each of which has a slot or groove, *d*, in its lower end, and such projections both enter the groove F. The filament is laid in the groove F, with its ends *c c* projecting, as shown, beyond the bridge H. The filament shown being a very fine one, knots are tied in its ends to hold them; but with the ordinary filaments, each of which forms an entire conductor, the usual enlarged ends would answer this purpose. It is evident that as the filament contracts, its ends being held beyond the fixed bridge H, the plate A will be drawn along the space G, which is long enough to allow of the whole contraction of the filament. The filament is thus allowed to contract freely, though under a constant and even strain. Said filament of course does not move, remaining always in the same position relative to the groove which holds it, and consequently is not injured by rubbing against the sides of the groove. There is also no danger of its slipping under the weight, as there is when loose weights are employed. The strip I is set across the groove F, being held by notches made for the purpose. This prevents the filament from slipping out of the groove. The rib of the cover, fitting in the groove in the outer block, assists in preventing the access of air to the filament. A number of these molds are piled one on top of another in a suitable closed flask, which is placed in a carbonizing-furnace. After carbonization, the molds are taken from the flask, when by removing the bridge H and strip I the flexible carbon filament may be taken out.

What I claim is—

1. A mold for carbonizing filaments, wherein the filament is kept under strain and always in the same position relative to the parts with which it is in contact, while allowed to contract freely, substantially as set forth.

2. In a mold for carbonizing filaments, the combination of a movable grooved plate for containing the filament, means independent of said plate for holding the ends of the filament, and an inclosing-chamber, substantially as set forth.

3. In a mold for carbonizing filaments, the combination, with an inclosing-chamber, of the grooved plate for shaping the filament, said plate acting also as a weight to keep said filament under strain, substantially as set forth.

4. In a mold for carbonizing filaments, the combination, with the grooved plate for holding said filament, of means preventing the filament from leaving the groove, substantially as set forth.

5. In a mold for carbonizing filaments, the combination, with the plate for holding the filament, of the inclosing-chamber and the bridge attached to the latter for securing the ends of said filament, substantially as set forth.

6. A flat shallow mold for carbonizing filaments, provided with means for holding such filaments under strain and permitting contraction during carbonization, in combination with a cover constructed to exclude air, substantially as set forth.

7. A flat shallow mold for carbonizing filaments, provided with means for holding such filaments under strain and permitting contraction during carbonization, and having an edge groove, in combination with a cover provided with a corresponding rib, substantially as set forth.

This specification signed and witnessed this 17th day of February, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

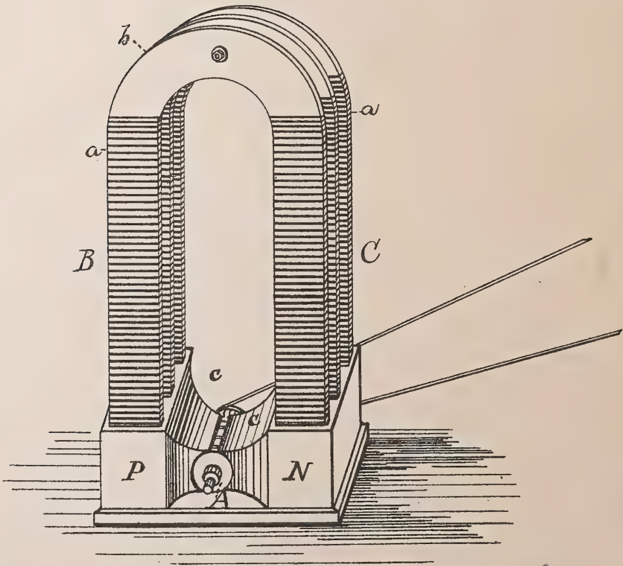
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

No. 287,523. Patented Oct. 30, 1883.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

BY Rich'd N. Dyer.

ATTORNEY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

DYNAMO OR MAGNETO ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 287,523, dated October 30, 1883.

Application filed September 13, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo or Magneto Electric Machines, (Case No. 436;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon.

The object I have in view is to produce a more efficient construction of the field-of force electro-magnet of dynamo or magneto electric machines, so that greater magnetic force can be produced than heretofore with the same mass of iron and with the same consumption of electrical energy. This I accomplish by employing, in connection with the polar extensions of a machine, two or more pairs of flat or plate magnet-cores made of soft iron and wound separately with insulated wire, through which the electric current passes. Each pair of flat soft-iron cores is preferably made in one piece, with a connecting back piece or yoke; but the back piece or yoke may be a separate piece secured to the flat cores. The pairs of flat cores being separately wound, they may be connected in series in the field-circuit in multiple arc or in multiple series. This construction of the field-of-force electro-magnet gives greater magnetic strength than the round cores wound separately, or cores made up of a number of flat plates covered with a common winding. In connection with this construction of the cores, to give still greater efficiency, the concentrating convergent polar extensions may be used.

The foregoing will be better understood from the drawing, which shows in perspective a machine embodying the invention.

A is the revolving armature, having a continuous bobbin connected with the bars of a commutator-cylinder, and being preferably itself of cylindrical form, and P N are the polar extensions of the field electro-magnet. These polar extensions have attached to them two or more pairs of flat soft-iron cores, B C, which are separately wound with insulated wire, as shown at *a*, forming part of the field-circuit. The yoke *b*, connecting each pair of flat soft-iron cores, is preferably made in one piece with the cores. The magnet-cores may be arranged in a vertical or in a horizontal position, and be attached to one side only of the polar extensions, or to opposite sides of the same.

To obtain greater efficiency, the polar extensions P N are constructed with bevel surfaces *c*, so as to contract the field-of-force vertically or horizontally, or in both directions. Machines constructed in this way have corresponding advantages when used as electric engines or motors.

I do not claim herein the convergent pole-pieces, or the pole-pieces forming a cylindrical space in which the armature revolves, or the polar extensions, each made in one piece and provided with two or more cores, these inventions being claimed in my application No. 71,756; and it is to be understood that all other patentable features of invention shown or described, but not claimed herein, are reserved for protection by other patents, and have been or will be embodied in other applications for patents.

What I claim is—

1. In a dynamo or magneto electric machine, the field-of-force electro-magnet having two or more pairs of flat soft-iron cores provided with separate windings and two polar extensions, to which all of such cores are attached, substantially as set forth.

2. In a dynamo or magneto electric machine, the field-of-force electro-magnet composed of two polar extensions and two or more pairs of flat soft-iron cores having separate windings and magnetically-separate yokes or back pieces, substantially as set forth.

3. In a dynamo or magneto electric machine, the field-of-force electro-magnet having two polar extensions and two or more pairs of flat soft-iron cores provided with separate windings and yokes made integral with the cores, substantially as set forth.

4. In a dynamo or magneto electric machine, the combination, with the armature, of the convergent polar extensions, the flat soft-iron magnet-cores provided with separate windings and two polar extensions, to which said cores are attached, substantially as set forth.

This specification signed and witnessed this 3d day of June, 1882.

THOS. A. EDISON.

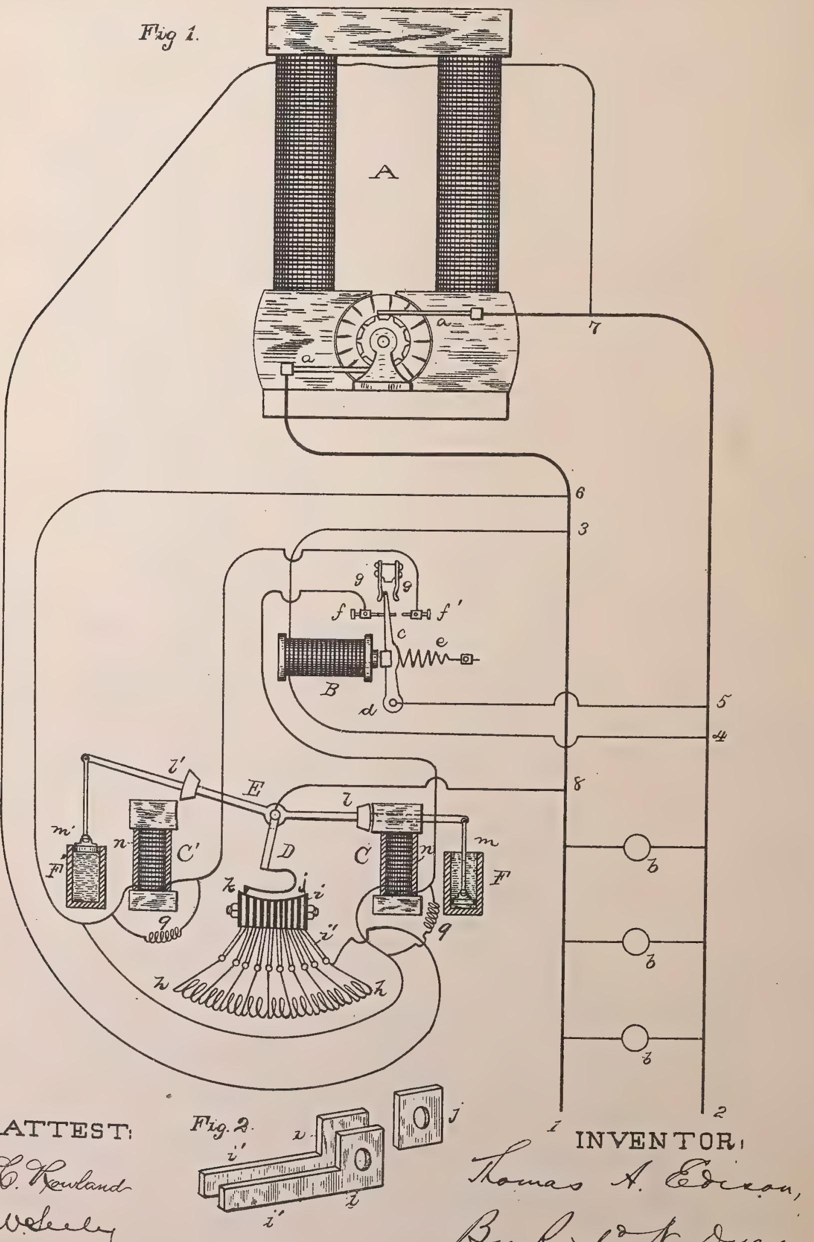
Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 287,524. Patented Oct. 30, 1883.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer, Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 287,524, dated October 30, 1883.

Application filed December 8, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Regulators for Dynamo-Electric Machines, (Case No. 526,) of which the following is a specification.

The object I have in view is to produce a simple and efficient apparatus for regulating the generation of current by dynamo or magneto electric machines which supply current to multiple-arc systems of electrical distribution, such regulation being accomplished by an adjustable resistance which affects the circuits energizing the field-of-force magnets of such machines.

In carrying out my invention the field-magnet coils of the generator preferably form part of a multiple-arc circuit derived from the main conductors of the machine, though the field-magnet may be energized from an external source, if desired. In another multiple-arc circuit from the main conductors is placed an electro-magnet provided with a pivoted spring-retracted armature, which armature forms part of a third multiple-arc circuit. The free end of the armature is normally held centrally between two contact-points, and as it is drawn in one or the other direction, by the magnet or by the spring, it completes circuit through one or the other of two operating electro-magnets, each placed in a division of the third multiple-arc circuit. The "pressure" or regulating electro-magnet, which is located in a derived or multiple-arc circuit, so as to be affected exactly as is a lamp or other transmitting device, if wound with copper wire, as heretofore, is unduly affected by changes in temperature, which modify its resistance to such an extent that the adjustment is destroyed. To overcome this difficulty I wind this regulating electro-magnet with German-silver wire, or wire of other metals or alloys not unduly affected by changes in temperature. Instead of having the operating electro-magnets in a multiple-arc circuit, they may be in a shunt-circuit from one of the main conductors, or other circuit having sufficient energy to work them. In the field-circuit of the generator are placed a resistance and an arm for adjusting said resistance. The adjusting-arm is attached to a centrally-pivoted bar, near each end of which is placed an armature which is attracted by one of the pair of operating electro-magnets and worked across the face of such magnet, and to each end of the bar is also attached a plunger entering a dash-pot filled with liquid. As one or the other magnet is energized one end or the other of the pivoted arm is drawn down, the movement being retarded and regulated by the plungers, and the adjusting-arm is thus moved in one or the other direction, so as to throw in or cut out resistance from the field-circuit, according to the requirements of the system. The operating electro-magnets are provided with means for preventing or diminishing the spark at the contact-points of the armature-lever of the regulating-magnet due to the breaking of a magnet-circuit, such means consisting, preferably, of a shunt around each operating-magnet, which provides a path other than that across the break at the contact-points for the current due to the discharge of the magnet, and also of a copper tube or cylinder surrounding each operating magnet-coil to provide a local or short circuit for the extra or induced currents. The dash-pot plungers are so formed and adjusted that their action will be in unison with the charging and discharging times of the field-magnet, so as to prevent oscillation of the pivoted bar and contact-arm, for if the plunger were so adjusted as to fall too quickly the resistance would be placed in or taken out of circuit too rapidly, so that the current would increase or decrease so as to cause an opposite movement of the plunger, and the plunger would vibrate until the proper point of regulation was reached, when it would stop; but the plungers being regulated so as to move in accordance with the conditions of the field-magnet the contact-arm will move to the proper point at once and will remain there without vibrating.

The commutator for the adjustable resistance is of a novel and efficient form, the object in view being to so construct a resistance that a very slight movement of the adjusting-arm will be sufficient to cause a considerable variation in the resistance. Such commutator consists of a number of thin metal plates,

forming the contacting parts of the resistance, fastened together by an insulated pin or bolt, and having plates of mica or other similar insulation between them. The metal plates have outwardly-extending tongues, which are spread out in fan shape, and wires are connected with them, which include the resistance-coils, a considerable number of such coils being included between each pair of plates. The resistance is varied by means of a contact-point attached to a flexible contact-arm, such arm being attached to the pivoted center of the bar which carries the armatures and plungers, so that as such arm moves the contact-arm is carried in one direction or the other, and the contact-point slides over the edges of the contact-plates of the resistance, throwing the resistance-coils in or out of circuit as it moves from one plate to the next.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 represents an apparatus embodying the same, mostly in diagram; and Fig. 2 is a representation of the plates of the adjustable resistance.

A is the field-magnet, and *a a* are the commutator-brushes of a dynamo or magneto electric machine.

1 2 are main conductors leading from the machine, and having lamps or other translating devices, *b b*, arranged in multiple arc upon them.

In a multiple-arc circuit, 3 4, is placed an electro-magnet, B, wound with German silver, for the purpose before set forth, and having an armature, *c*, pivoted at *d*, and retracted by an adjustable spring, *e*. The armature-lever *c* forms part of the operating-circuit 5 6. Its free end is provided with contact-points, and such end plays between other contact-points, *f f′*. The armature is normally held midway between *f* and *f′* by spring-fingers *g g*. The circuit 5 6 is divided, one division including an electro-magnet, C, the other an electro-magnet, C′, which electro-magnets are the operating-magnets.

The field-magnet A is energized by the current in the multiple-arc circuit 7 8. In this circuit are connected the resistance-coils *h h* and the flexible contact-arm D. The wires from the coils *h h* are connected with the fingers *i′* of the metal commutator-plates *i*, such plates *i* having plates *j*, of mica or other suitable insulation, between them. The mica insulation only separates the bodies of the plates *i*, the fingers *i′* being spread out into a fan shape, as shown in Fig. 1, to permit of the attachment of the wires thereto. The contact-point *k*, attached to the spring-arm D, rests on the edges of the plates. The contact-arm D is attached to the middle of the pivoted bar E. To the bar E are attached armatures *l l′*, one for each of the magnets C C′, which armatures work across the faces of the polar extensions of the magnets, so as to have an increased movement. Plungers *m m′* are attached one to each end of the bar E, entering, respectively, dash-pots F F′, containing liquid.

As the number of lamps in the main circuit is increased the decrease of current in the circuit 3 4 causes the spring *e* to draw armature *c* away from magnet B, completing circuit at *f′* through magnet C′, attracting armature *l′*, and throwing up armature *l*, and so moving spring-arm D and contact *k* as to remove a portion of the resistance *h h* from the field-circuit 7 8, the movement being regulated by the plungers *m m′*, which, as stated, are adjusted to act in unison with the charging and discharging times of the field-magnet, such adjustment being obtained by varying the size of the plungers, or of the apertures in them, until the proper adjustment is obtained, or in any other suitable way.

It is evident that only one plunger might be employed, attached to either end of the pivoted bar E and properly adjusted.

The removal of lamps from circuit by causing the magnet B to attract armature *c* against contact-point *f* causes magnet C to attract armature *l* and place resistance in the field-circuit. Around each magnet C C′ is placed a shunt-circuit, 9, to form a path for the discharge of the magnet when the circuit is broken at *f f′*, and prevent the destruction of these contact-points by the spark. Around each magnet-coil is a non-magnetic cylinder, *n*, (shown in section,) for the purpose before explained.

I do not claim herein any of the devices covered by my patents numbered 265,783 and 264,660.

The resistance-commutator, *per se*, is not claimed herein, but will be included in a separate application for patent; and it is to be understood that all features of patentable novelty described or shown, but not claimed herein, are reserved for protection by other patents, and have been or will be included in other applications for patents.

What I claim is—

1. In regulators for electrical generators, the combination, with the regulating electro-magnet, of the oppositely-acting operating electro-magnets and armatures moving across the faces of the polar extensions of such operating-magnets, substantially as set forth.

2. The combination, with a dynamo or magneto electric machine and translating devices arranged in multiple arc, of an adjustable resistance for regulating the generation of current, an arm for varying such resistance, a pivoted bar carrying said arm and having armatures at the ends thereof, two electro-magnets acting oppositely on said bar, the armatures of which move across the faces of the polar extensions of said operating electro-magnets, and a controlling electro-magnet located in a multiple-arc circuit, substantially as set forth.

3. In regulators for electrical generators of the character herein described, the combina-

tion, with the operating electro-magnets, of the regulating electro-magnet wound with German silver, or other alloy or metal not unduly affected by changes in temperature, substantially as set forth.

4. The combination, with the adjustable resistance and the arm for varying the same, of the two operating electro-magnets acting oppositely upon armatures moving across the faces of the polar extensions of said electro-magnets and working the arm in opposite directions, and one or more dash-pots and plungers for retarding the movement of said arm, substantially as set forth.

5. The combination, with the adjustable resistance in the field-circuit of the generator and the arm for varying the same, of the regulating and operating electro-magnets and the dash-pots and plungers, said plungers being adjusted, as explained, to act in unison with the charging and discharging times of the field-magnet, substantially as set forth.

6. The combination, with the controlling-magnet B, its armature-lever, and the contact-points of said lever, of the magnets in the divided circuits from said contact-points, and means for preventing the spark at such points, due to the discharge of the magnets, substantially as set forth.

7. The combination, with the controlling electro-magnetic switch and the operating electro-magnets, of shunts around said operating-magnets, and metallic shells upon the same, for preventing spark at the contact-points of said switch, substantially as set forth.

8. The combination, with the resistance-commutator, such as described, of the flexible contact-arm carrying a contact-point, the pivoted bar carrying said spring-arm, the operating electro-magnets acting oppositely upon said bar, and one or more dash-pots and plungers for retarding the movement of said bar, substantially as set forth.

This specification signed and witnessed this 28th day of November, 1882.

THOS. A. EDISON.

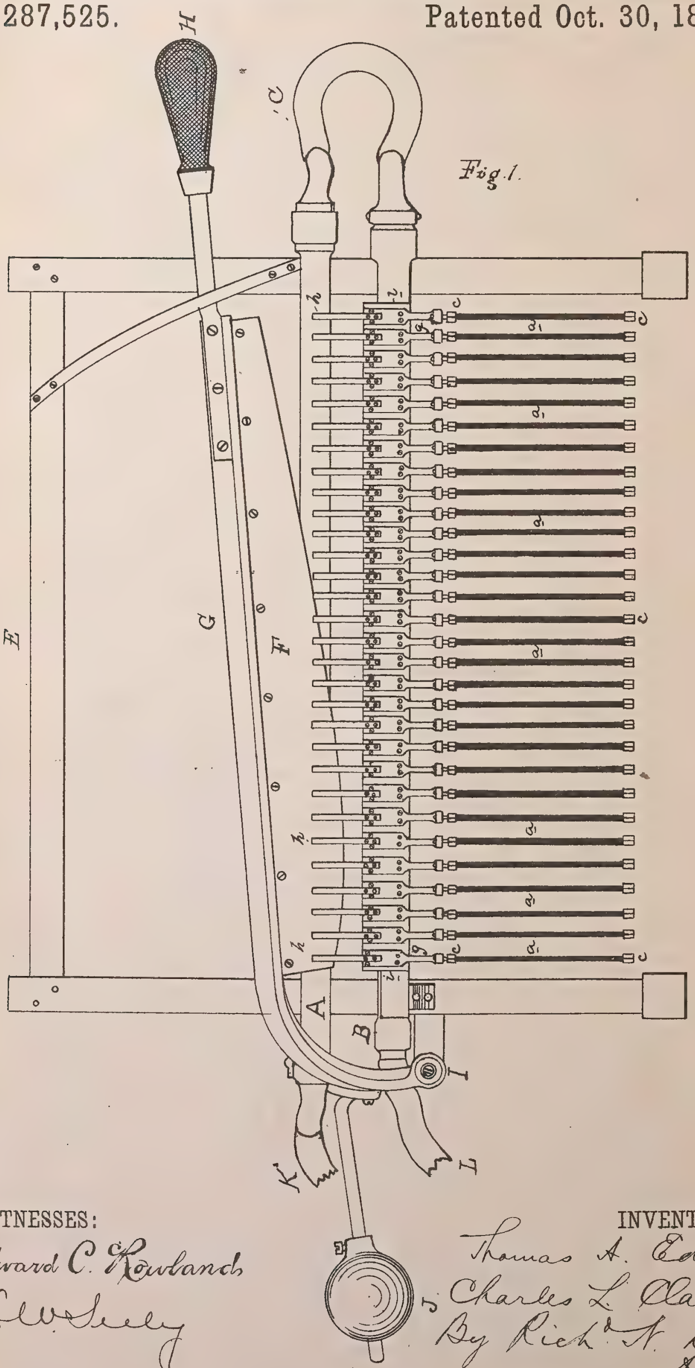
Witnesses:
H. W. SEELY,
E. H. PYATT.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON & C. L. CLARKE.

REGULATOR FOR SYSTEMS OF ELECTRICAL DISTRIBUTION.

No. 287,525. Patented Oct. 30, 1883.



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(No Model.) 2 Sheets—Sheet 2.

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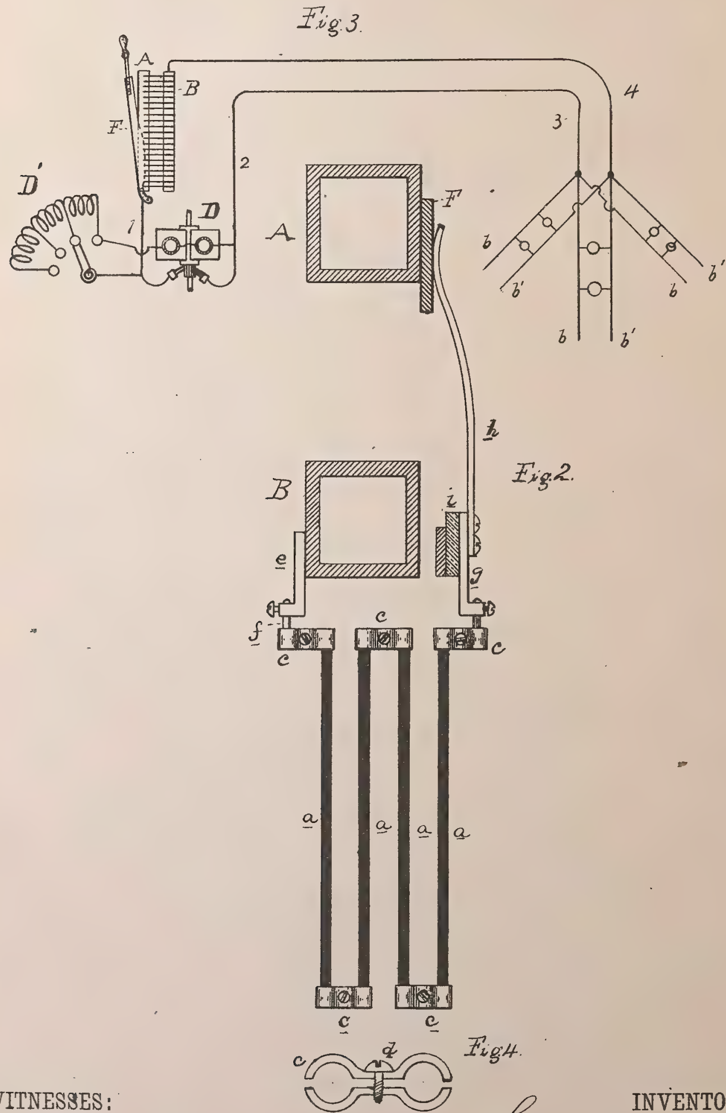

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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, AND CHARLES L. CLARKE, OF NEW YORK, N. Y., ASSIGNORS TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR SYSTEMS OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 287,525, dated October 30, 1883.

Application filed October 20, 1882. (No model.) Patented in England October 14, 1882, No. 4,884, and in France October 31, 1882, No. 151,841.

To all whom it may concern:

Be it known that we, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, and CHARLES L. CLARKE, of the city, county, and State of New York, have invented a certain new and useful Improvement in Regulators for Systems of Electrical Distribution, of which the following is a specification.

Our invention relates to a regulating apparatus used in connection with a system of electrical distribution in which the current is distributed from a central point to various parts of a district where lamps, motors, and other translating devices are arranged in multiple arc. In such a system the generators at the central station are connected with feeding-circuits on which no lamps are placed, but which are connected at suitable points with the street-mains on multiple-arc circuits from which the lamps are placed. In such a system it is necessary to preserve a constant electro-motive force or "pressure" in the circuits where the translating devices are placed. The electro-motive force at the end of a feeding-circuit is indicated by a suitable device placed at the central station and connected by an auxiliary circuit with the end of the feeding-circuit, and it is regulated in accordance with such indications by varying the resistance of the feeding-circuit, all of which is fully set forth in the application of the said Edison filed December 9, 1881, (Serial No. 47,468.) According to our invention, this variation is accomplished by causing each feeding-circuit to be broken at a convenient point, and providing a number of paths for the current across such break, each of considerable resistance, means being provided for throwing into circuit more or less of such paths, as desired. Such paths or resistances, it will be understood, are in multiple-arc relation to each other, and consequently the more we place in circuit the less the resistance of the feeder and the greater the amount of current supplied to the lamps.

It is usually customary to vary the resistance of a circuit by throwing more or less resistance in series, so to speak, directly into such circuit. We, however, prefer the mode just described, for here as fast as we decrease the resistance, and thereby increase the current in the circuit, we correspondingly increase the current-carrying capacity of this portion of the circuits per unit of length, while in the old way, when the current is increased, the conductivity of the circuit remains the same, and there may be danger of exceeding the capacity of the conductors. The preferable form of apparatus for this purpose we have found to be as follows: The wire or cable from one pole of the generator or generators is connected to one of two metal pipes, preferably of copper, which are placed, preferably, one above the other, or in any convenient position. The conductor from the other pole is connected directly to the feeding-circuit, while the return-conductor of such circuit is connected with the second pipe. It is understood that each feeding-circuit of the district is provided with the apparatus described. To the lower pipe are attached, at short distances apart and along its entire length in any suitable manner, the ends of the carbon rods, the other end of each of which is connected with the lower end of a spring whose upper end approaches nearly to but does not touch the upper pipe. Preferably a number of these carbon rods are placed in series between the lower pipe and each spring. Pivoted at one end to the frame which supports the pipes is a "knife," consisting of a suitable back and a handle of insulating material, with a copper plate or blade, such blade being preferably broad at its outer end and narrow near the handle. Such knife is so placed that the blade can be forced down between the upper pipe and the springs and make electrical connection between them, more or less of the springs being in contact with the pipe, according as the blade is pressed down or drawn up.

It is evident that as more springs are connected with the pipe more of the carbon rods will be placed in multiple arc between the pipes,

and consequently the greater will be the conductivity of the feeding-circuit of which such pipes form a part. Therefore, when more translating devices are placed in the consumption-circuit in the vicinity of the point of connection between the feeder and such circuit, the blade is pushed down and more of the rods thrown into circuit, and when such devices are removed from circuit the blade is raised. At one end the pipes are connected by a rubber or other tube, and one pipe is connected at its other end to a source of water-supply, so that a circulation of water is kept up and the pipes are kept cool. A weight is attached to the knife as a counter-balance to hold it in the position in which it is placed; or a spring or suitable friction devices may be used for this purpose. Each dynamo or magneto electric machine of the battery of such machines supplying the feeding-circuits is regulated for the total number of translating devices in circuit in any suitable way, preferably by throwing resistance into and out of its field-circuit, while the adjustable resistances in the feeder-circuits are used to regulate for the unequal distribution throughout the system (the variations in location of translating devices) without reference to the total number of translating devices in circuit.

Instead of the form of variable resistance above described, the calorimeter-barrels shown in the application of Edison above referred to may be used, the knife above described being employed to place a greater or less number of the wire coils in circuit.

Our invention may be better understood by reference to the annexed drawings, in which—

Figure 1 is a front elevation of the regulating apparatus; Fig. 2, a transverse vertical section of the same; Fig. 3, a diagram illustrating the circuit-connections, and Fig. 4 a top view of the clamp which holds the carbon rods.

A and B are the two pipes, filled with water and connected together by rubber tube C.

Referring to Fig. 3, a main conductor, 1, from the generator or generators represented at D is connected to the pipe A, while main conductor 2 is connected to the conductor 3 of the feeding-circuit 3 4. Such feeding-circuit runs to a point where the circuits *b b'*, which supply the translating devices of the system, are connected to it in multiple arc. The conductor 4 of the feeding-circuit is connected to the pipe B. D' is the adjustable resistance in the field-circuit of the generator D.

Referring to Figs. 1 and 2, E is a suitable frame, which supports the pipes A and B. *a a* are carbon rods having their ends held in clamps *c*, such clamps being preferably of the form shown in Fig. 4—viz., being made in two parts, each part consisting of two curves joined together by a straight piece, and a screw, *d*, being passed through the straight portion of both, so that a double clamp is formed for holding two carbons. Metal pieces *e* are attached at one end to the side of pipe B, and to the other end of each a piece, *f*, is attached, which enters the clamp *c*, whose other half holds a carbon rod. Four of these rods are shown in Fig. 2 as connected in series, the end of the last carbon being attached to the piece *g*, to which is fastened the spring *h*, which approaches nearly but does not touch the pipe A. All the pieces *g* are secured to the strip *i*, which is of wood or other insulating material. F is a copper blade, of the form shown in Fig. 1, attached to a suitable back, G, and having a handle, H. The knife thus formed is pivoted at I. Such knife, it will be seen, can be forced down between the springs *h* and the tube A to any desired distance and again withdrawn, thus connecting the pipes through more or less of the carbon rods *a a*, and increasing or diminishing the conductivity of the feeding-circuit 3 4. The conductors are fastened to the pipes in any suitable manner. J is a counterbalance-weight used to hold the knife in the position in which it is placed. By means of rubber tube K water is introduced into pipe A, which flows off through tube L.

It is to be understood that all patentable features of invention shown or described but not claimed herein are reserved for protection in other patents, and have been or will be embodied in other applications for patents.

What we claim is—

1. The combination, with an opened electrical circuit, of a series of resistances connected in multiple arc with the circuit on one side of the break, separate spring-terminals to such resistances, a conductor connected with the circuit on the other side of the break and crossing said spring-terminals in close proximity thereto, and an intermediate circuit-controlling device making a sliding or rubbing contact between said conductor and more or less of the resistance-terminals, substantially as set forth.

2. The combination, with the parallel conductors, of the carbon resistances attached to one conductor, the springs attached to such resistances, and the copper blade for electrically connecting more or less of such springs with the other conductor, substantially as set forth.

3. The combination, with an electrical circuit, of a resistance, an adjusting device for throwing the resistance into and out of circuit, and a water-pipe for conducting off the heat, the circuits of the resistance being made and broken upon such water-pipe, substantially as set forth.

4. The combination, with an electrical circuit, of a series of exposed carbon rods serving as resistances, means for throwing such rods into and out of circuit, and a water-pipe for conducting off the heat, the circuits of the

carbon rods being made and broken upon such water-pipe, substantially as set forth.

5. The combination, with an opened electrical circuit, of metallic water-pipes forming the terminals of the circuit, resistances in multiple arc between such water-pipes, and means for throwing the resistances into and out of circuit, substantially as set forth.

This specification signed and witnessed this 4th day of October, 1882.

THOS. A. EDISON.
CHAS. L. CLARKE.

Witnesses:
H. W. SEELY,
E. H. PYATT.

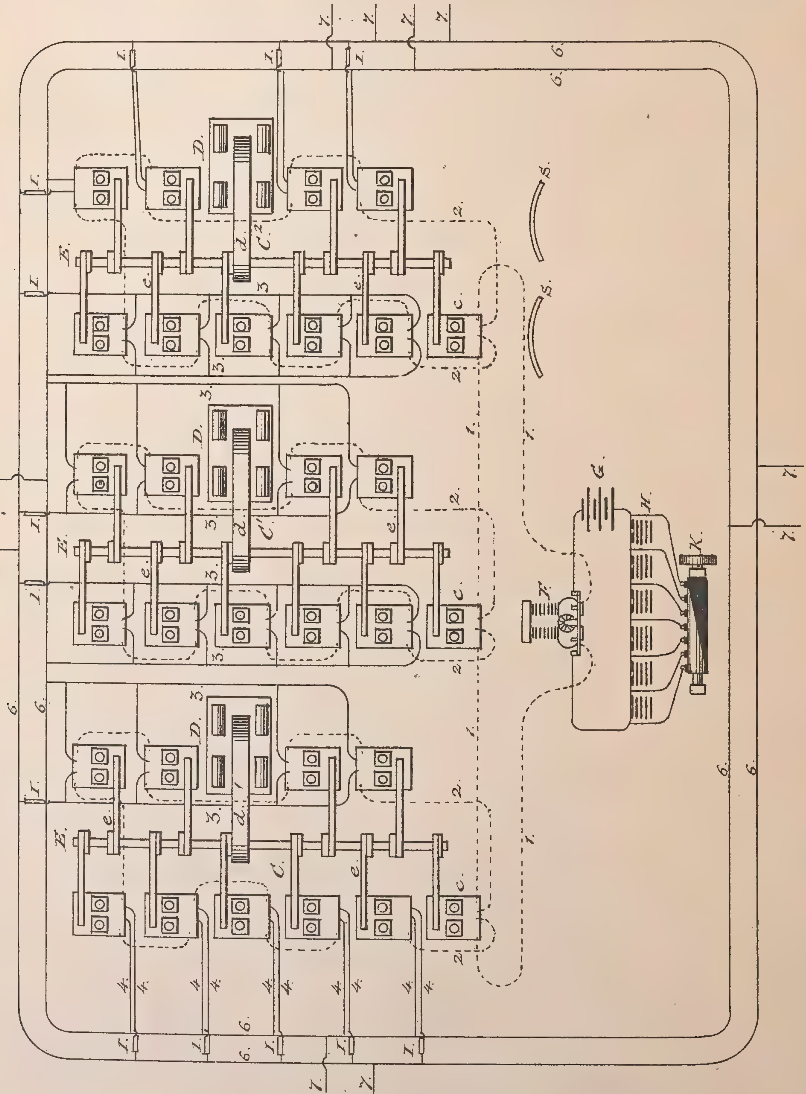
(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

REGULATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

No. 288,318. Patented Nov. 13, 1883.

Fig. 1.



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M. J. Clagett.

T. A. Edison
Inventor
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N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2

T. A. EDISON.

REGULATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

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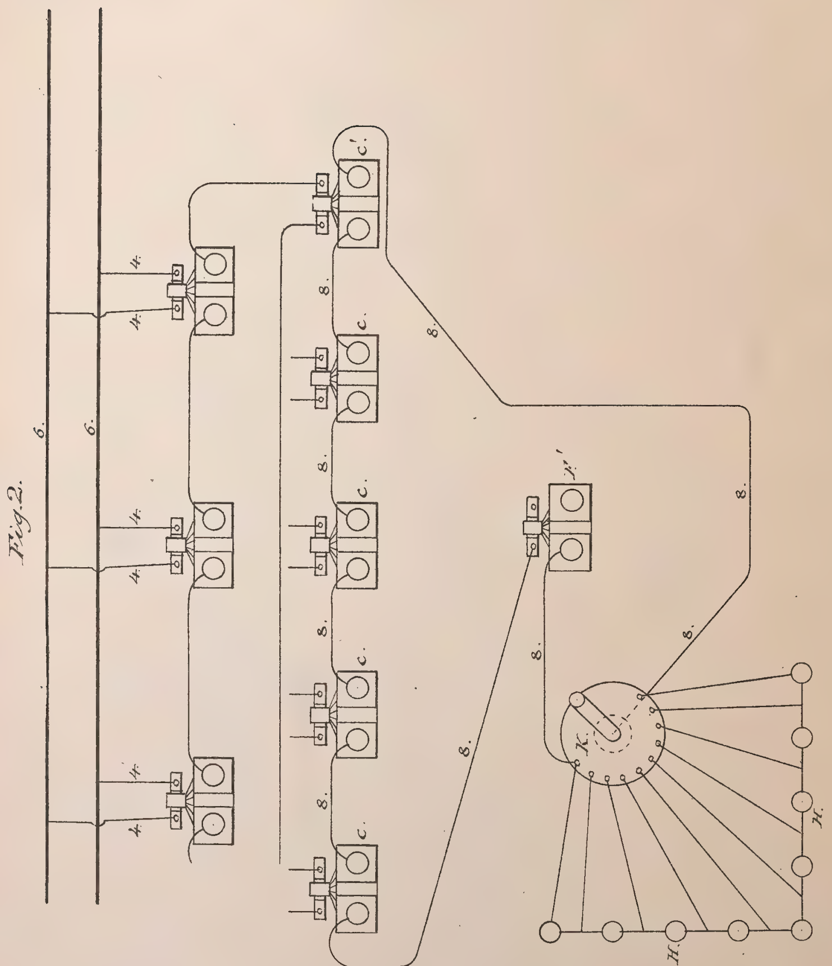

Attest;
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T. A. Edison
Inventor;
per Dyer & Wilber
Atty's

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO OR MAGNETO ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 288,318, dated November 13, 1883.

Application filed November 11, 1881. (No model.) Patented in England January 3, 1880, No. 33, and February 11, 1880, No. 602; in Italy May 10, 1880; in Belgium May 15, 1880, No. 51,329; in Victoria June 14, 1880, No. 2,841; in India June 23, 1880, No. 405; in France July 5, 1880, No. 136,399; in Canada July 21, 1880, No. 11,527; in New South Wales July 26, 1880; in Sweden July 29, 1880; in Queensland August 3, 1880; in Austria-Hungary October 5, 1880; in New Zealand October 18, 1880, No. 485; in Portugal October 27, 1880, No. 628; in Spain November 10, 1880, and in Norway December 31, 1880.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Regulation of Dynamo or Magneto Electric Machines, (Case No. 358;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In a prior application for Letters Patent of the United States, made by me on February 5, 1880, of which this application is a division, is set out a complete system for the generation, indication, regulation, distribution, consumption, and measurement of electricity for light and motive power. In such system it is contemplated that all the generation, indication, and distribution for a large number of consumers be done at a central station, such central station being the supply center of an area termed a district therein.

In such a system the net resistance of the external circuit is likely to be constantly varying, inasmuch as it is likely that the number of translating devices in circuit and making demands upon the central station for current will be constantly varying. This would lead to variation of pressure, so to speak, of current in the circuit. It is essential, however, that just sufficient energy be generated and sent through the circuit to keep up an equal flow through each translating device—that is, that a uniform pressure be maintained in the circuit of each translating device in circuit, whether more or less such devices be in circuit. To supply the demands upon such a central station of a district, it is necessary that a large number of generators be there grouped, arranged so that more or less thereof shall be thrown into action, that the amount of their action shall be controlled so that just the needed supply may be furnished.

To so arrange a number of generators that the generative capacity of all in circuit at any one time may be readily and definitely regulated by one operation, or the operation of one device, in order that the essentials before set forth be attained, is the object of this invention, which is particularly hereinafter set out and claimed.

A number (two or more) of generators are arranged to be driven by any suitable prime motor. If these were used as dynamo-machines proper—that is, if the field-of-force coils and the generating coils were included in one circuit, and all the current generated were passed through the field-magnet coils, a very much greater amount of current than necessary for the maintenance of a practical magnetic maximum in the field-of-force magnets would be passed around them, and the coils acting as resistances to the energy in excess of that required to magnetize the magnets to their practical maximum, a great waste of energy would ensue. Hence the field-of-force coils and the generating-coils are kept separate, one machine of the number before alluded to being set apart to supply the energy for the field-of-force coils of the remainder of the number, the number given it to feed being properly adjusted to its capacity. The one so set apart is for convenience hereinafter termed the "field-generator," and it and the generators fed by it are termed "supply," "generative," and, collectively, a "battery." This field-generator may be energized by the current from a galvanic battery or other source of energy, or it may be a dynamo-machine, its own field-coils being included in its own circuit. With it are combined means for varying instantly and at will the strength of the current passing around its field. As such variation reacts upon the field-magnets correspondingly varying the magnetic field in which its generative coils rotate, the reaction extends to the current generated, varying the force of the fields of the supply-generators, and hence ultimately the current sent therefrom into the circuit external to the station. It will be understood that this regulation of the magnet of the field-generator is performed below the point of saturation of the magnet,

the current supplied to the magnet-coils being varied from a quantity sufficient to produce saturation, as a maximum, to a quantity producing the weakest magnetic effects desired as a minimum. So, by simply regulating the current passing around the field of one machine, the generation of current by a large number of machines connected to a supply-circuit is regulated instantly and at will.

When it is desired to use several batteries of generators, one in each battery is set apart as the field-generator; but the entire number of field-generators are energized by an extra generator provided with means of regulation, in which case such extra generator is termed the "prime field-generator." The foregoing is clearly shown in the drawings, in each of which several batteries of generators are indicated, and in which Fig. 1 shows a prime field-generator energized by the current of a galvanic battery; and Fig. 2 shows the prime field-generator as a dynamo. In Fig. 1 three batteries, C C′ C², of generators are shown, which number may be increased or diminished as circumstances may require. In each battery one generator, *c*, is set apart as the field-generator, the circuit therefrom passing through the field-coils of all the remaining or supply generators of the battery, as shown in broken lines 2 2. For actuating the rotative portions of the supply-generators an engine, D, is used with each battery, connected by belt *d* to line of shafting E, from which belts *e* pass to the supply-generators; or, if preferred, each supply-generator may be provided with its own special engine. The generative coils of the supply-generators in C′ and C² are connected in multiple-arc to conductors 3 3, which in turn are connected in multiple-arc to the main conductors 6 6, from which lead supply-conductors or "mains" 7 7 throughout the district or territory to be supplied; or the supply-generators may be connected directly in multiple-arc to 6 6, as shown in C. The field-of-force coils of the field-generators *c c c* are energized by current from the prime field-generator F, whose circuit for this purpose is shown in broken lines 1 1. As here shown, its field-coils are traversed by current from the galvanic battery G, although it is evident that any other suitable source of energy may be used. In the circuit of G is interposed a series, H, of resistances connected to a cut-out, K, by which more or less of said resistances are thrown into the circuit of G. This forms a very effective and simple method of regulating the generative capacity of the batteries of supply-generators, for by the resistances the current in the field-coils of the prime field-generator is strengthened or weakened, affecting its generation, which reacts upon the field-generators *c*, reacting then upon the supply-generators, the variation in the circuit of G being immediately followed by variation in the current generated in the batteries.

Where only one battery is to be used, the resistances and cut-out are placed directly in the field-circuit of the field-generator *c* of such battery.

In Fig. 2, *c c c c* are the field-generators of batteries not shown, while *c′* is the field-generator of a battery of which three supply-generators are shown, connected to conductors 6 6, as before explained. In this case the prime field-generator F′ is a dynamo-electric machine, all its coils being included in one circuit, 8 8, which passes through the field-coils of the field-generators *c c c c c′*. The same principle of regulation is used, however, the resistances H and cut-out K being arranged, as shown, directly in the circuit 8 8, through F′, causing variation therein, with the result hereinbefore explained—that is to say, the current flowing in the field-magnet circuit 8 8 of the generators *c c′* is primarily and directly varied by variations in the resistance H in said circuit.

The adjustable resistances, which are placed directly in the circuit of the field-magnet coils in either of the arrangements shown, are so proportioned to the resistance of the magnet-coils and to the energy of the source of electrical supply, and these last two elements are so proportioned with relation to each other that when all the resistance is cut out of circuit the current supplied to the field-magnet coils will be sufficient only to saturate or nearly saturate the magnet, producing the maximum magnetic power without waste of energy. The throwing of the resistance into the circuit diminishes the current and weakens the magnet, and in this way the strength of the magnet is primarily and directly regulated and varied.

I do not claim herein the method of operating a battery of generators, consisting in using the entire current of one to supply the fields of the remainder, and throwing the entire current generated by the latter into a circuit for use, as such will form the subject of a separate application; nor do I claim herein a dynamo-electric machine constructed or combined with suitable devices for primarily varying the strength of the current exciting its field-coils, nor, broadly, the combination, with the field-coils of such a machine, of an adjustable resistance, as such subject-matters form the subject of a separate application.

It is to be understood that all further patentable features of invention described or shown, but not claimed herein, are reserved for protection by other patents, and have been or will be embraced in other applications for patents.

What I claim is—

1. The combination, with an electrical generator, of an adjustable resistance in addition and external to the field-magnet coils, and located directly in the field-circuit of the generator, for primarily and directly regulating and varying the strength of the field-magnet below the point of saturation, substantially as set forth.

2. In a battery of generators, the combina-

tion of one generator feeding the field of all the supply-generators of the battery, with means for controlling and regulating its current, substantially as set forth.

3. The combination, with a battery of generators and a separate generator supplying the field-current therefor, of means acting on the separate generator to regulate its production of current, and thereby regulate the generative capacity of the entire battery, substantially as set forth.

4. The combination, with a series of batteries of generators, each provided with its own field-current generator, of a prime field-generator supplying the field-current to such battery field-generators, and provided with means for controlling the generative capacity, substantially as set forth.

5. The method of regulating the generative capacity of one battery or of a series of batteries of generators, consisting in primarily regulating the current passing around the field-coils of one or the prime field-generator, substantially as set forth.

6. The combination of a battery or series of batteries of generators, a field or prime field generator, and an adjustable resistance, substantially as set forth.

7. The combination, with the main circuit containing one or more generators and translating devices, of a separate electric circuit having no electrical connection with the main circuit, and supplied with current from a source external to said generator or generators, and means acting upon the separate circuit for controlling and regulating the force or pressure in the main circuit, substantially as set forth.

This specification signed and witnessed this 17th day of October, 1881.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

C. F. HARRINGTON.

(No Model.)

T. A. EDISON.

ELECTRICAL GENERATOR OR MOTOR.

No. 293,432. Patented Feb. 12, 1884.

Fig. 1.

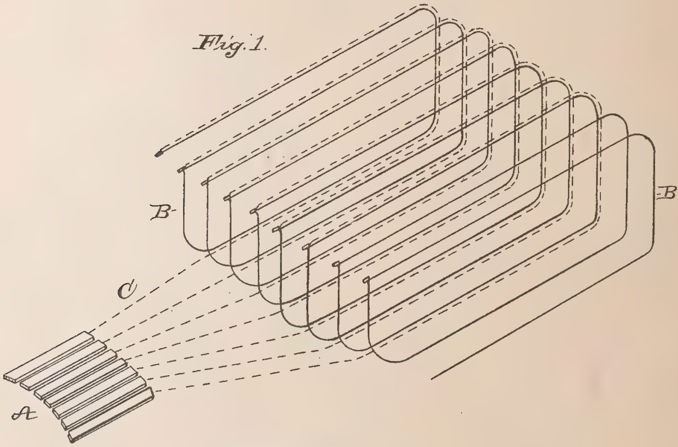


Fig. 2.

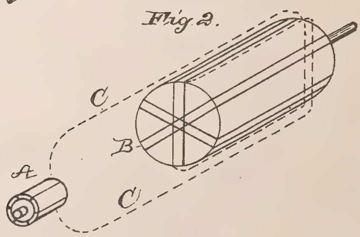
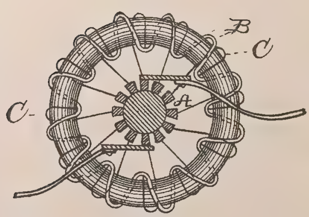


Fig. 3.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Rich^d N. Dyer

Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRICAL GENERATOR OR MOTOR.

SPECIFICATION forming part of Letters Patent No. 293,432, dated February 12, 1884.

Application filed October 18, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Generators or Motors, (Case No. 602,) of which the following is a specification.

This invention relates to the construction of dynamo-electric machines and electro-dynamic motors having continuously-wound bobbins connected at intervals to commutator-bars, whereby the sparking at the commutator will be greatly reduced or wholly obviated, overcoming the necessity for changing the current-collectors upon the commutator in accordance with variations in the load upon the machines when used either as generators or motors, increasing the capacity of the machine and decreasing the heat generated in the armature-coils, and also diminishing the wear of the commutators and the collectors. This I accomplish by opposing the electro-motive force of the coils as they are short-circuited at the commutator (by the bridging of commutator-bars by the current-collectors) by a counter electro-motive force. This counter electro-motive force is preferably equal or nearly equal to the electro-motive force of the short-circuited coils, in which case no current will flow in the short-circuited coils and the sparking will be completely obviated; or the counter force may be somewhat less or even greater than the direct force, but not sufficiently one way or the other to make the spark due to the current produced by the predominating electro-motive force of practical importance. The counter force is produced by making the connections between the bobbin and the commutator-bars through conductors which pass through the field of force, and in which there is a counter electro-motive force opposed to the direct force of the short-circuited coils. These connections are preferably in the form of loops upon the armature.

In machines with continuous windings, the commutator-bars have been heretofore connected with the armature-bobbin by conductors running directly from the commutator-bars to the bobbin. By this invention, however, each connection is made by a conductor which is connected to the bobbin, and is carried back on the armature-loop from the point of connection therewith, and follows it one or more times around the armature, and is then connected to a commutator-bar. The extra loops may be conductors of the same size as the bobbin; but much smaller conductors are preferably used, and since each extra loop is in circuit a portion of the time only, the heat due to the main current is dissipated. A counter force equal to the direct force is obtained by giving each extra loop the same length as one loop or section of loops of the main bobbin; or in constructions where this is not desirable the extra loops may be placed in advance of the loops of the main bobbin, so that as each main loop or section of loops is short-circuited the opposing extra loop or section of loops is in a stronger magnetic field, and in this way the counter force of the extra loop can be made equal or nearly equal to the direct force of the short-circuited loop.

This invention is applicable to all continuously-wound machines, whether of the Gramme, Siemens, or other type.

In the accompanying drawings, forming a part hereof, Figure 1 is a perspective view of a number of armature-loops removed from the armature and of a number of commutator-bars, the connections between the loops and bars being shown by dotted lines; Fig. 2, a perspective view of a wound armature of the Siemens type and a commutator with two commutator-connections illustrated; and Fig. 3, a side elevation of a wound armature of the Gramme type with the commutator in vertical section, all the commutator-connections being illustrated.

A represents commutator-bars, and B the coils or loops of a continuously-wound armature. The field-magnet, the location of which will be well understood, is not shown in any of the figures.

C represents the conductors connecting the loops with the commutator-bars. These conductors are wound as loops upon the armature, and hence pass through the field of force, and in them is developed a counter electro-motive force, which neutralizes wholly or partially the electro-motive force of the coils as they are short-circuited. It will be seen that each conductor C, instead of extending from the point of connection with B directly to a commutator, is run back upon the coil B, to which it is connected, and follows that coil around the arma-

ture, and is then connected to a commutator-bar. If the winding B is a plural winding, each conductor C may also be wound two or more times around the armature. In Fig. 2 two connections only are shown for clearness; but it will be understood that the other commutator-bars will be connected in the same way with the armature-coils. In Fig. 3 the connections C pass once around the ring-armature before being connected with the commutator-bars; but these connections may be run two or more times around the armature, to give the required counter electro-motive force.

The operation is not dependent upon the resistance of the extra loops, but upon their length and position with reference to the corresponding main loops; and hence I make no claim herein to the interposition of an extra resistance between the commutator and the armature-coils. A construction dependent upon the resistance is described in my application Serial No. 114,282, and that invention is therein claimed. Neither do I claim herein a resistance external to the current-collectors forming a bridge of high resistance between the short-circuited commutator-bars, for this is claimed in my application Serial No. 114,281.

What I claim is—

1. The method of overcoming wholly or partially the spark at the commutators of dynamo or magneto electric machines or electro-dynamic motors, consisting in developing a counter electro-motive force opposed to the electro-motive force of the armature-coils as they are short-circuited, substantially as set forth.

2. In an electrical generator or motor, the combination, with the armature and commutator, of means for throwing a counter electro-motive force into the armature-coils as they are short-circuited, substantially as set forth.

3. In an electrical generator or motor, the combination, with the armature and commutator, of conductors connecting the armature-coils and commutator-bars and passing through the field of force, substantially as set forth.

4. In an electrical generator or motor, the combination, with the armature-coils and the commutator-bars, of extra loops wound upon the armature, and connecting the armature-coils and commutator-bars, substantially as set forth.

This specification signed and witnessed this 17th day of October, 1883.

THOS. A. EDISON.

Witnesses:

WM. H. MEADOWCROFT,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

INSULATION OF RAILROAD TRACKS USED FOR ELECTRIC CIRCUITS.

No. 293,433. Patented Feb. 12, 1884.

Fig. 1.

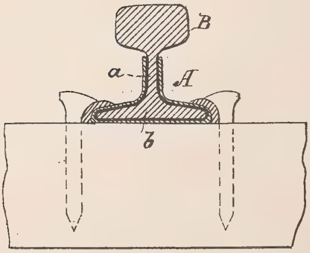


Fig. 2.

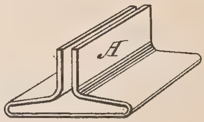


Fig. 3.

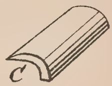


Fig. 4

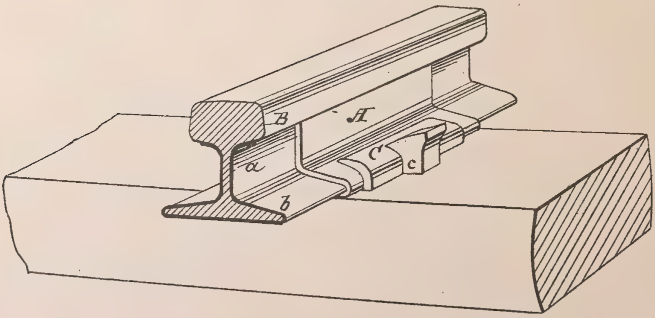
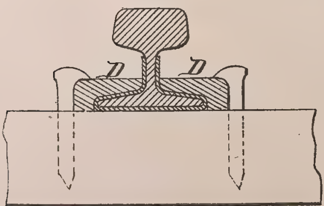


Fig. 5.



WITNESSES:

Wm Carman

James A Payne

INVENTOR:

T. A. Edison

BY Dyer and Wilber

ATTORNEYS.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE ELECTRIC RAILWAY COMPANY OF THE UNITED STATES, OF NEW YORK.

INSULATION OF RAILROAD-TRACKS USED FOR ELECTRIC CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 293,433, dated February 12, 1884.

Application filed August 9, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Insulation of Railroad-Tracks Used as Electric Circuits, (Case No. 238;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This invention relates particularly to the better insulation of lines of rails when the rails of each line of rails are electrically united and form conductors for conveying an electric current for utilization along the line of rails. Where it is attempted to use the rails of a railroad-track as the conductors for an electrical current, there is always more or less surface-conduction, the amount depending largely upon the dampness or dryness of the adjacent soil, the ties, &c.

The object of this invention is to largely reduce or to prevent entirely this surface-conduction, to which end the invention consists in the features more particularly hereinafter described and claimed.

Between the rail and the tie is placed a piece of felt, papier-maché, or other tough flexible insulating material, preferably so treated as to make it water-proof, which piece extends upward on the web on both sides of the rail to the head, forming an insulating-shoe. Between it and the spike is placed a piece of metal, of the general configuration of the foot of the rail, upon which the head of the spike takes and bears, so that the insulating material is protected from abrasion or damage by the spike. Instead of this metal piece, a much heavier piece of wood may be used, forming a shoe fastened down by the spike, and in turn securing the rail.

It will be observed that the insulating material which is placed under and around the rail where it rests on the tie is a tough material. Rubber will not answer the purpose; but a flexible water-proof fibrous material is preferred. The foot and web of the rails are covered with some elastic insulating composition adhering to the surface—for example, a rubber paint, or a paint of which the base is pure linseed-oil, the ties, for a space of, say, one-half foot to a foot on each side of the rails, being similarly painted.

In the drawings, Figure 1 is a cross-section, and Fig. 4 a perspective, of a rail arranged as described. Figs. 2 and 3 are views of details; Fig. 5, a cross-section of a modification of Fig. 1.

A is a piece of felting, papier-maché, vulcanized fiber, or other tough flexible insulating material, placed under and around the rail B, and extending up the web *a* to about the head of the rail, forming an insulating-shoe.

C is a washer-piece, of metal, which is placed between A and the spikes, protecting A from injury by the spikes. In place of the piece C, wooden pieces D may be used.

The foot *b* and web *a* of the rails are covered with some elastic insulating composition, leaving only the head of the rail exposed or in condition to form a connection for conduction of current. This composition may be a rubber paint or a paint having a base of pure linseed-oil, or any oxidizable oil. By these means surface conduction or leakage is almost, if not entirely, obviated, causing increased economy in the use of electric motors for traction purposes on railroads.

What I claim is—

1. A railway-rail provided with an insulating-covering except upon its head, substantially as set forth.

2. An insulating-cushion for railroad-rails, composed of a flexible water-proof fibrous material, substantially as set forth.

3. A line of rails electrically connected to form a circuit or part of a circuit, and having the foot and web of the rails covered with an elastic insulating composition adhering to the surface thereof, substantially as set forth.

This specification signed and witnessed this 6th day of August, 1880.

THOS. A. EDISON.

Witnesses:
F. L. GRIFFIN,
WM. CARMAN.

(No Model.)

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 293,434. Patented Feb. 12, 1884.

Fig. 1.

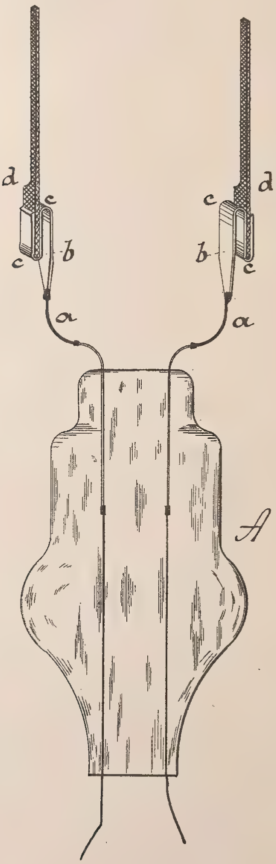
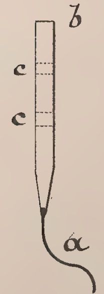


Fig. 2



WITNESSES:

D. D. Mott

H. W. Seely

INVENTOR:

T. A. Edison

BY Richd. N. Dyer

ATTORNEY.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 293,434, dated February 12, 1884.

Application filed August 7, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescing Electric Lamps, (Case No. 377;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

I have found that in the manufacture of incondescent electric lamps the best mode of attaching the incandescing conductor to the wires leading thereto is to electroplate the joint or union between them. In order to perform this operation, it is necessary to first attach the wires to the enlarged end of the carbon by some temporary mechanical means. To furnish convenient and efficient means for this purpose is the object of my invention. My arrangement is as follows: The copper inner extremities of the "leading-in" wires are formed into long flat strips, whose width should be about equal to that of the enlarged ends of the carbon. Each strip is then bent over twice lengthwise on itself, and the enlarged carbon ends are inserted in the upward bend. The sides of the strip may be pressed down upon the carbon as closely as is necessary to hold it. The joint is then electroplated, preferably in the manner shown in my previous application, (Serial No. 24,440.)

The accompanying drawings illustrate my invention.

Figure 1 is a view showing the carbon held as above described, and Fig. 2 a view of the flat copper extremity before bending.

A is the supporting neck or stem of an incandescing electric lamp, and *a a* the copper terminals, having their ends formed into or attached to flat strips *b b*. Each of these strips is bent back twice upon itself at points *c c*. The enlarged ends *d d* of the carbon are placed in the upward bends, as shown, and there held during the operation of electroplating.

What I claim is—

1. In an incandescing electric lamp, the device for holding an end of the carbon during the process of electroplating, consisting of a flat piece of copper bent twice lengthwise upon itself, substantially as set forth.

2. The leading-in wires of an incandescing electric lamp, having their inner extremities formed into or attached to flat metal strips, each bent twice lengthwise upon itself, substantially as and for the purpose set forth.

This specification signed and witnessed this 5th day of December, 1881.

T. A. EDISON.

Witnesses:
H. W. SEELY,
WM. H. MEADOWCROFT.

(No Model.)

T. A. EDISON.

ELECTRICAL METER.

No. 293,435. Patented Feb. 12, 1884.

Fig. 1.

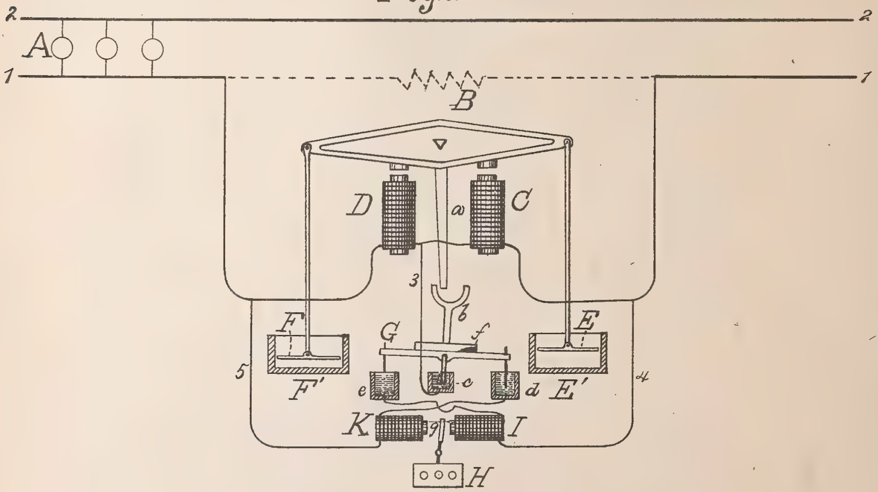
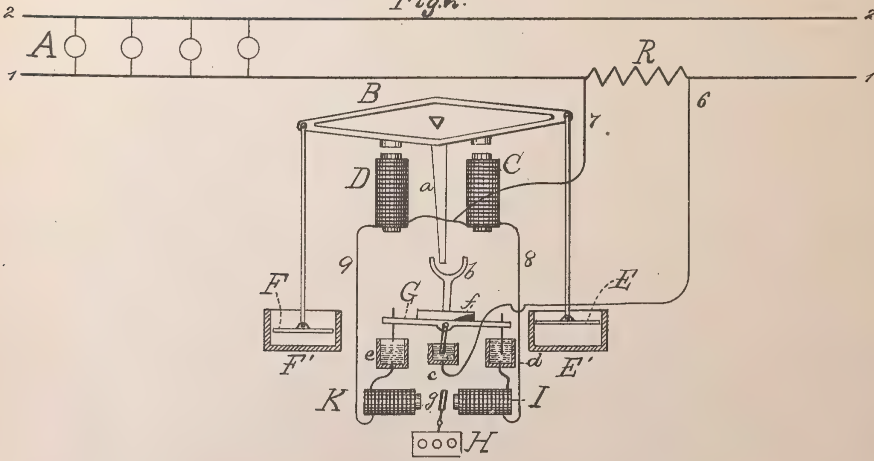


Fig. 2.



WITNESSES:

E. C. Rowland,

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer,

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRICAL METER.

SPECIFICATION forming part of Letters Patent No. 293,435, dated February 12, 1884.

Application filed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Meters, (Case No. 457;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce simple and efficient means for measuring the electrical energy consumed in a circuit, which will record automatically, and will be constructed wholly of mechanically-operating parts not liable to get out of order and not requiring renewal. This I accomplish by the use of one or more reciprocating dash-pot plungers, which retard the movement of an electro-magnetic mechanism operated by the current in the circuit, or a portion thereof, and working, by its movement, a recording apparatus. The dash-pot or dash-pots employed may be of ordinary construction; but, instead of using a liquid in the dash-pots, I prefer to use the air as a retarding force, which I am enabled to do effectively by making the plungers of large area. The electro-magnetic mechanism acts upon a pivoted beam, to which the dash-pot plungers are attached. It may be of any suitable construction; but I prefer to employ two electro-magnets, acting upon armatures secured to a pivoted or suspended beam on opposite sides of the point at which the beam is pivoted or suspended. The beam is connected at its ends to the reciprocating plungers of dash-pots, which retard the movement. These electro-magnets are located directly in the circuit or in a shunt therefrom. The beam has an arm which works a pivoted circuit-controller, making and breaking contact at mercury-cups. When the electro-magnets are located directly in the circuit, the movement produced by each electro-magnet opens a shunt around the other electro-magnet and closes a shunt around itself. The electro-magnets are thus made to predominate alternately, while the circuit is kept constantly closed. When the electro-magnets are in a shunt from the circuit the consumption of electrical energy in which is being measured, the circuit-controller makes and breaks the circuits of the electro-magnets alternately or closes and opens shunts, as in the first case. The circuit-controller is a pivoted bar having a U-shaped arm projecting upwardly, and engaging with an arm from the pivoted beam. The circuit-controlling bar carries two points dipping alternately in mercury-cups, and a central point dipping permanently in the mercury of a third cup. To throw the circuit-controlling bar to the limit of its movement after it has been moved over the center by the arm from the beam, I employ a tube partly filled with mercury. This tube is carried by the bar, and the mercury in it flows to one end or the other as the bar tips over the center, throwing it to the end of its movement. A weight may be employed for this purpose, as heretofore in circuit-controllers of this character; but the mercury-tube is preferred.

The recording apparatus may be worked by a mechanical connection with the pivoted beam or the circuit-controller; but it is preferred to employ two electro-magnets for this purpose, the circuits of which are made and broken alternately by the circuit-controller. When the main electro-magnets are located directly in the circuit, these electro-magnets for working the recording apparatus will be located in the shunt-circuits which are completed alternately around the main magnets; but when the main electro-magnets are in a shunt from the circuit, the recording electro-magnets can be placed in the divisions of this shunt with the main electro-magnets. The lamps, motors, or other translating devices are preferably arranged in multiple-arc circuits. The speed of the electro-magnetic mechanism will vary with the number of translating devices in circuit, and the recording apparatus will indicate accurately in any units desired the electrical energy consumed in the circuit.

The foregoing will be better understood from the drawings, in which—

Figure 1 is a view, partly diagrammatic, of the preferred form of meter located directly in the circuit; Fig. 2, a similar view of the preferred form of meter located in a shunt from the circuit.

1 2 are the main conductors of a house or

other consumption circuit in which are placed lamps, motors, or other translating devices, A, preferably arranged in separate multiple-arc circuits, as shown.

The meter is composed of a pivoted or suspended beam, B, Figs. 1 and 2, carrying armatures on opposite sides of its pivot, acted upon by two electro-magnets, C D. At its ends the beam B is connected with reciprocating dash-pot plungers E F, which are preferably of large area and work against the retarding force of the air in cylinders E′ and F′, closed at one or both ends. The beam B has an arm, *a*, projecting downwardly from its center and engaging with the U-shaped stirrup on the end of the arm *b* of a pivoted circuit-controlling bar, G. This circuit-controller carries a central pin dipping permanently in the mercury of a cup, *c*, and two end pins dipping alternately in the mercury of cups *d e*. The bar G has a tube, *f*, partly filled with mercury, secured thereto, for throwing the circuit-controller to the limit of its movement after it is tipped over the center by the movement of the beam B.

H represents any suitable recording apparatus, which may be moved by a mechanical connection with the beam or circuit-controller; but it is preferably worked by two electro-magnets, I K, acting alternately upon an armature-lever, *g*.

With reference to Fig. 1, the electro-magnets C D are placed directly in the conductor 1 of the consumption-circuit. Between the electro-magnets C D a connection, 3, is made with the permanent contact-cup *c*. Outside of the electro-magnets C D connections 4 and 5 are made with mercury-cups *e* and *d*, respectively, after passing through the coils of the recording electro-magnets I and K. Conductors 3, 4, and 5 form shunts around the magnets C D, which are completed alternately by the circuit-controller, while the main circuit always remains closed.

When the parts are in the position shown in Fig. 1, the current flows from 1 on the right of C D, through C, 3, *c*, G, *d*, K, and 5, to 1 on the left of C D. Current will also flow through D, but, the shunt 3 5 being closed around D, its energy will be small compared with that of C. C will draw B down until G is thrown over the center, when contact will be broken at *d*, and made at *e*. K will also attract *g*, working the recording apparatus. Now the current will flow from 1 on the right of C D, by 4 I *e* G *c* 3 D, to 1 on the left of C D. The shunt 3 4 is now closed around C, and hence D will now predominate, although a small current will flow through C. The beam B will be tipped in the opposite direction, and I will attract *g*. This same arrangement of circuits could be used in a shunt around resistance, in which case the conductor 1 would be extended, through resistance, around the magnets C D, as shown in dotted lines in Fig. 1.

In Fig. 2 the magnets C D are in a shunt, 6 7, around resistance R, located in conductor 1 of the consumption-circuit. Conductor 7 is divided, and runs to both magnets C D, and from these magnets separate connections 8 9 extend to magnets I K and cups *d e*. Conductor 6 extends directly to the cup *c*. In the position shown in the drawings, the current flows from 1 on the right of R, by 6, *c*, G, *d*, I, 8, C, and 7, to 1 on the left of R. Magnets C I are energized, while the circuit of D and K is broken. The beam B will be attracted by C, and the lever *g* by I. The circuit-controller will be thrown after the beam B has made a definite movement, breaking contact at *d*, and making contact at *e*. Now the current will flow from 1 on the right of R, by 6, *c*, G, *e*, K, 9, D, and 7, to 1 on the left of R, and D K will be energized, while the circuit of C I will be broken.

It will be understood that the speed of movement of the electro-magnetic mechanism varies in direct proportion to the variation in the energy consumed in the circuit in a given time, and hence the recording apparatus will give an accurate record of the consumption that takes place.

What I claim is—

1. In an electrical meter, the combination of the pivoted beam, oscillated by an electro-magnetic mechanism for moving the beam in both directions by electro-magnetic action, of a recording apparatus, and reciprocating dash pot plungers attached to such beam, substantially as set forth.

2. In an electrical meter, the combination, with a pivoted beam, of electro-magnets for tipping such beam in opposite directions, a circuit-controller moved by the beam, and a recording apparatus, substantially as set forth.

3. In an electrical meter, the combination, with a pivoted beam, of electro-magnets for tipping such beam in opposite directions, means for retarding the movement, a circuit-controller moved by the beam, and a recording apparatus, substantially as set forth.

4. In an electrical meter, the combination, with the pivoted beam, the main electro-magnets, and the dash-pots, of the circuit-controller operated by the beam, the recording apparatus, and the electro-magnets for working such recording apparatus, substantially as set forth.

5. In an electrical meter, the circuit-controller composed of a pivoted bar, mercury-cups in which the circuit is made and broken, a mercury-cup for constantly maintaining electrical connection with the moving bar, and a tube partly filled with liquid, for throwing the bar to the limits of its movements, substantially as set forth.

This specification signed and witnessed this 7th day of July, 1882.

THOMAS A. EDISON.

Witnesses:
RICHD. N. DYER,
EDWARD H. PYATT.

(Model.)

T. A. EDISON.

TYPE WRITER.

No. 295,990. Patented Apr. 1, 1884.

Fig. 1.

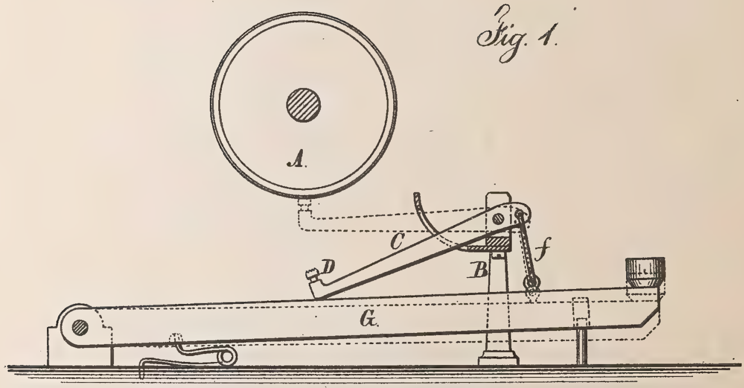
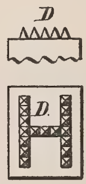


Fig. 2.



Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor.

Thomas A. Edison.

per Lemuel W. Serrell.

N PETERS. Photo-Lithographer. Washington. D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

TYPE-WRITER.

SPECIFICATION forming part of Letters Patent No. 295,990, dated April 1, 1884.

Application filed December 9, 1878. Renewed May 25, 1883. (Model.) Patented in England October 29, 1875, No. 3,762; in France May 6, 1876, No. 112,719; in Belgium May 8, 1876, No. 39,502; in Austria August 23, 1876, No. 26,935; in Italy August 26, 1876, No. 8,733, and in Canada September 6, 1876, No. 6,508.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Duplicate Printing, (Case No. 167,) of which the following is a specification.

In Letters Patent No. 180,857, granted to me, I have set forth a pen for perforating paper, and a press in which the perforated paper is stretched in a frame, and ink from a roller forced through the perforations, and an impression made on a sheet of paper laid on a bed.

Type-writing machines have been made in which the type is impinged upon the paper to produce an impression, and in stamp-canceling machines types have been used having roughened or pointed surfaces.

My invention relates to the method of producing printed impressions in duplicate, consisting in pressing upon paper types in succession each of which has a surface of points so as to perforate the paper, and then forcing through the perforations ink upon the sheet of paper, and thereby printing upon the same.

In the drawings, Figure 1 is a section representing one key and lever of a type-writer, and Fig. 2 is a side and face view of the letter magnified.

A is the roller upon which the paper to be perforated is secured, in the usual manner, felt, blotting-paper, rubber, or other soft material being placed over the roller, and against this the paper to be perforated lies.

B is the standard or part of a ring, and all the type-levers are arranged so that the perforating-types upon their extreme ends will strike one common center at the roll A. Only one lever and perforating-type is shown in the drawings.

C is the type-lever; D, the type; *f*, the wire to the finger-key G.

The surface of each type is composed of numerous fine points that will perforate the paper when pressed upon it. The paper, after it has been perforated by the types in the words, lines, and sentences required for one page, is removed from the type-writing machine, and the printing is performed by forcing ink through the perforations upon a sheet of paper in a manner similar to that set forth in my said Patent No. 180,857. It will be evident that these perforating-types may be introduced into any type-writing machine in which sufficient force can be applied to perforate the paper and form a stencil of type-letters, each letter being composed of numerous perforations.

This method of printing is to be distinguished from that in my aforesaid patent, because each perforated letter is made complete by the pressure of a type, whereas in the said patent the letters or characters had to be written or drawn out by hand, and hence could not be made as rapidly or perfectly as by the impression of a type of numerous points. This method is also to be distinguished from the stamp-canceling devices in which a single stamp is forced into the paper to perforate or mar the same in a manner to prevent alteration, and the perforated paper was not used for printing with ink. My method of printing, therefore, necessarily comprises all of the successive operations, and is an improvement in duplicate printing.

I claim as my invention—

The method herein specified of producing printed impressions in duplicate, consisting in impressing upon paper types in succession, each of which has a surface of points, so as to perforate the paper, and then forcing ink through the perforations upon the sheet to be printed, substantially as set forth.

Signed by me this 4th day of December, A. D. 1878.

THOMAS. A. EDISON.

Witnesses:

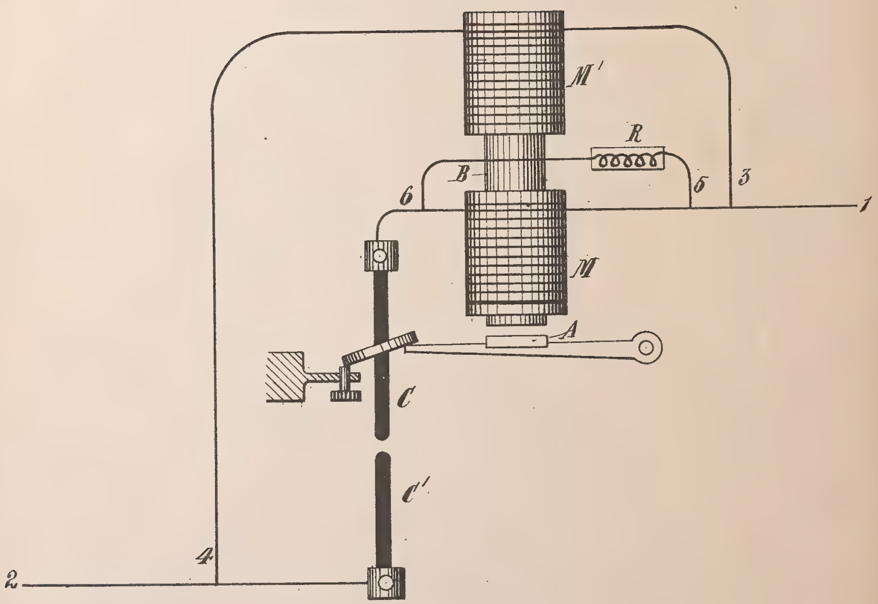
STOCKTON L. GRIFFIN,
GEO. E. CARMAN.

(No Model.)

T. A. EDISON.

ELECTRIC ARC LIGHT.

No. 297,580. Patented Apr. 29, 1884.



WITNESSES:

D. D. Mott

Thomas E. Birch.

INVENTOR:

T. A. Edison

BY Dyer & Weber

ATTORNEYS.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC-ARC LIGHT.

SPECIFICATION forming part of Letters Patent No. 297,580, dated April 29, 1884.

Application filed November 28, 1881. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric-Arc Lights, (Case No. 368;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is to produce means for governing the regulating mechanism of voltaic-arc lamps which will be simple in construction and efficient in action by the employment of opposing solenoids or electro-magnets having coils of the same resistance.

In carrying out my invention I arrange the coils of one solenoid or electro-magnet in the line or arc circuit, and the coils of the other solenoid or electro-magnet in a shunt-circuit around the carbons and the first solenoid or electro-magnet. Around the solenoid or electro-magnet in the line I form a shunt containing a resistance, which is proportioned to make a proper division of the current and to increase to the required degree the current-carrying capacity of the line over that of the shunt around the arc. This resistance is preferably made adjustable. The coils of the two solenoids or electro-magnets are wound in opposite directions, and may act upon the same or different movable cores or armatures. It will be understood that the magnet or solenoid in the line, while of the same resistance as that in the shunt around the arc, has a greater number of coils in its winding, so as to give it a predominating force when the carbons are in contact. This is accomplished by making the wire of the magnet or solenoid in the line of greater conductivity per unit of length than that of the magnet or solenoid in the shunt, the length being increased to equalize the resistance. Where they act upon the same movable or stationary core, one set of such coils can be wound upon the other.

Heretofore, in regulating arc-lamps by the differential action of opposing solenoids or electro-magnets, one of such solenoids or electro-magnets has been made of low resistance and placed in the line, while the other solenoid or electro-magnet located in the shunt around the arc has been made of much higher resistance; but by the use of the shunt-circuit around the solenoid or electro-magnet in the line, and by providing the magnet with a greater number of coils in its winding, I am enabled to make both of such solenoids or electro-magnets of the same resistance.

The foregoing will be better understood from the drawing, in which the figure is a diagrammatic view of my arrangement.

1 2 represent the line in which are placed the carbons C C′ and the coils of the solenoid or electro-magnet M.

3 4 represent a shunt-circuit around the carbons and the solenoid or electro-magnet M.

In 3 4 are placed the coils of the solenoid or electro-magnet M′. Both M and M′ are shown as surrounding the same stationary core B and acting on the same armature A which is arranged to control the regulating mechanism. M and M′, being wound in opposite directions, act oppositely upon the core B and armature A.

Around the electro-magnet or solenoid M is a shunt-circuit, 5 6, which is connected with the line on opposite sides of M, and is provided with a proper resistance, R, which is preferably adjustable. When the lamp is first put in circuit, the carbon-points are together; but the passing of the current through the magnet M energizes said magnet, which, acting on the armature A, draws the upper carbon, C, away from the lower one, C′, a sufficient distance to cause the formation of the voltaic arc. When the carbons become consumed, however, and the resistance of the main circuit which contains the arc becomes greater, a greater portion of the current flows through the shunt 3 4, energizing the magnet M′, which, acting in opposition to the magnet M, causes the armature A to drop and let the carbon C fall the proper distance. It is evident that in practice this operation after the arc is once formed would be a continuous one.

What I claim is—

1. In regulating mechanism for arc-lamps, the combination of the opposing solenoids or electro-magnets located one in the line and the

other in a shunt around the arc, both of such solenoids or electro-magnets having the same resistance, substantially as set forth.

2. In regulating mechanism for arc-lamps, the solenoid or electro-magnets of the same resistance located in the line and in a shunt around the arc, in combination with a shunt around the solenoid or electro-magnet in the line, substantially as set forth.

This specification signed and witnessed this 7th day of November, 1881.

THOS. A. EDISON.

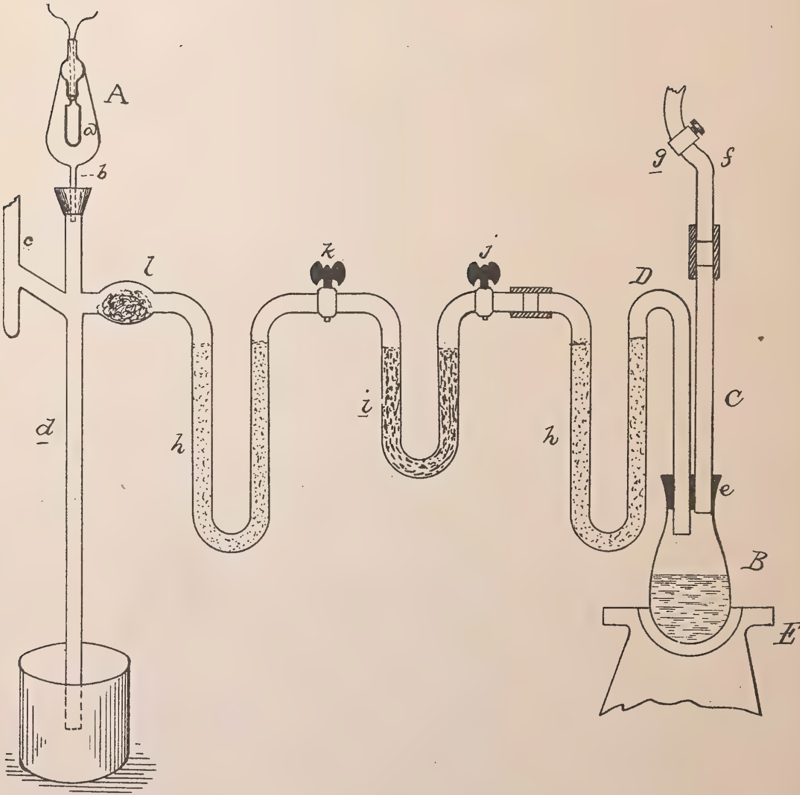
Witnesses:
RICHD. N. DYER,
H. W. SEELY.

(No Model.)

T. A. EDISON.

INCANDESCENT ELECTRIC LAMP.

No. 297,581. Patented Apr. 29, 1884.



WITNESSES:

Edw. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd N. Dyer,

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 297,581, dated April 29, 1884.

Application filed September 22, 1882. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in the Manufacture of Incandescing Electric Lamps, (Case No. 483,) of which the following is a specification.

The object of this invention is to render the inclosing-globes of incandescing electric lamps as free from air as possible; and said invention consists in providing such globes with a residual atmosphere of carbonic monoxide as nearly as possible free from air. To accomplish this, I first remove the air from the globe as completely as it can be done with a Sprengel vacuum-pump, and then fill the globe with carbonic monoxide in a pure state and free from moisture. This is in turn pumped out, and the globe is refilled with the gas, this being repeated until the small amount of residual gas remaining in the globe consists almost entirely of carbonic monoxide, and this of course to the exclusion of the same amount of air.

A convenient apparatus for carrying out my invention is represented in the accompanying drawing.

A represents the inclosing-globe, and *a* the carbon filament of an incandescing electric lamp. Such globe is attached by tube *b* to the Sprengel vacuum-pump, of which *c* is the supply-tube and *d* the fall-tube.

B is a glass vessel, closed by an air-tight rubber stopper, *e*, in which are inserted tubes C and D. The tube C opens in the air, terminating in a rubber tube, *f*, provided with a pinch-cock, *g*, so that the opening may be closed. The tube D connects the vessel B with the Sprengel pump. This tube contains phosphoric anhydride *h h*, or similar drying agent, and caustic potash *i*. It is provided with stop-cocks *j* and *k*, and with a bulb, *l*, containing cotton for preventing the substances in the tube from being drawn out when the pump is working. The vessel B contains sulphuric acid and ferro-cyanide of potassium, and means (represented at E) are provided for heating the same. Such heating produces carbon monoxide. The stop-cocks *j* and *k* are left closed, and the cock *g* open until the vessel B becomes full of this gas, which displaces the air previously contained therein. The gas is then allowed to enter the lamp, from which the air has been exhausted, its moisture being removed by the phosphoric anhydride, and any carbonic acid which may have been given off is taken up by the caustic potash. After the globe is filled with the carbon monoxide the gas is pumped out and a second quantity allowed to enter. This is removed, and these operations are continued until only the smallest possible amount of carbonic monoxide, remains in the globe. During the latter stages of the operation the carbon filament of the lamp is heated to high incandescence by an electric current in order that the occluded gases may be driven off. The lamp is sealed off at *b*, and is then ready for use.

I am aware that British Patent No. 192 of 1879 describes the passing of a stream of carbon gas constantly through openings in a lamp-globe. This, however, forms no part of my invention, which relates only to lamps having sealed globes.

What I claim is—

The sealed globe of an incandescing electric lamp, provided with a residual atmosphere consisting almost entirely of carbonic monoxide, substantially as set forth.

This specification signed and witnessed this 12th day of September, 1882.

THOS. A. EDISON.

Witnesses:
WM. A. STERN,
H. W. SEELY.

(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 297,582. Patented Apr. 29, 1884.

Fig. 2.

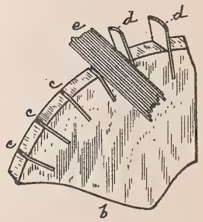
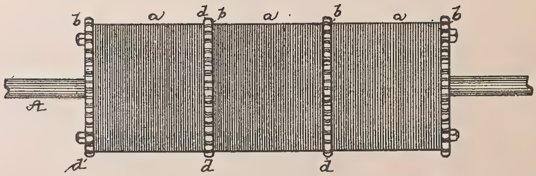


Fig. 1.



ATTEST:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd N. Dyer,
Atty.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 297,582, dated April 29, 1884.

Application filed June 29, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines, (Case No. 575,) of which the following is a specification.

In the operation of large dynamo-electric machines it is sometimes found that when a heavy load is on the machine the resistance to the revolution of the armature is such as to tend to draw the wires wound thereon out of place, a strain being produced on said wires which might in some cases be so great as to break the connections between a coil and the commutator.

The object of my invention is to obviate this difficulty.

The armature-core which I prefer to use consists of a number of thin magnetic disks strung on a shaft, or on an insulating sleeve or hub, as set forth in my Patents Nos. 264,649 and 265,785; and my invention consists in the use of supports attached to said disks, between which the wires are wound longitudinally. Such supports act to prevent the strain on the wires, as the latter bear against the supports, and cannot therefore be displaced.

The preferable manner of carrying my invention into effect is to provide several thicker disks arranged at intervals among the ordinary disks of the core. Each of these thicker disks is provided with a number of slots or notches in its periphery. In each of such notches is inserted a slip or thin piece of a suitable material, preferably an insulating substance. These slips project radially from the disks to which they are attached, longitudinal rows of projecting supports being thus formed upon the core. Vulcanized fiber is a very suitable material for these supports. The wires which form the inductive portion of the armature are wound longitudinally between the supports, which prevent the wire from being drawn out of place to an injurious extent.

The invention is illustrated in the annexed drawings, in which Figure 1 is a view in elevation of an armature-core embodying said invention, and Fig. 2 a view of a portion of one of the thicker plates of said core.

A is the armature-shaft, on which are placed the thin disks of magnetic metal *a a*, which may or may not be separated from the shaft by a sleeve or hub of insulating material. Several thicker plates, *b b*, are interposed among the plates *a*, and each plate *b* is provided with a number of slots or notches, *c c*, each notch on one plate being in a line with one on each of the other plates. In each notch is placed a thin slip, *d*, of vulcanized fiber or any other suitable material. The wires *e* upon the cylinder are wound between the slips *d*, which act as previously described.

What I claim is—

1. The combination, with a solid cylindrical armature-core composed of disks strung on a shaft, and coils wound longitudinally thereon, of supports projecting from certain of said disks, forming longitudinal projecting rows, between which said coils are wound, substantially as set forth.

2. The combination, with the ordinary disks of the armature-core, of interspersed disks having slots or notches in their edges, and projecting supports inserted in said slots or notches, substantially as set forth.

3. The combination, with the ordinary thin disks of the core, of the interspersed thicker disks provided with projecting supports for the coils, substantially as set forth.

This specification signed and witnessed this 25th day of June, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 297,583. Patented Apr. 29, 1884.

Fig. 1.

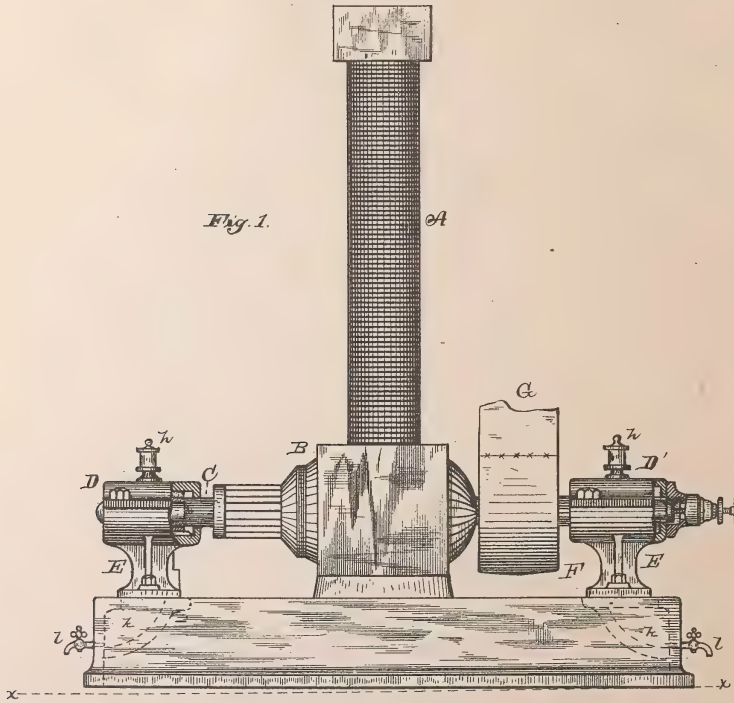


Fig. 3.

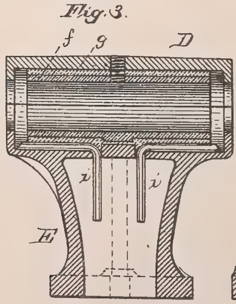


Fig. 4.

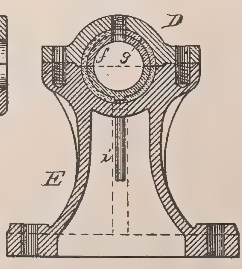
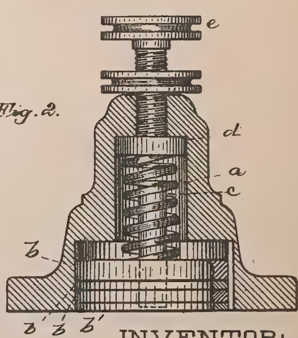


Fig. 2.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd. N. Dyer
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 297,583, dated April 29, 1884.

Application filed October 10, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines, (Case No. 587,) of which the following is a specification.

This invention relates to the bearings in which the armature-shaft of a dynamo-electric machine is supported, my objects being to produce an even wear upon the journals, preventing grooves from being worn therein; to produce also an even wear upon the commutator-cylinder of the machine; to produce an effectual lubrication by distributing the oil over the whole length of the journals, and to retain the surplus oil which runs down from the bearings, instead of allowing it to drip over the sides of the pillow-blocks upon the floor.

In carrying out my invention I so support the armature-shaft that it is free to move slightly in either longitudinal direction. There will then be a slight oscillation of the shaft back and forth in its bearings, caused by the jar of running the machine, or from other causes. This oscillation works the oil along the whole length of the journals, so as to produce an even lubrication, and also prevents any grit or hard particles from remaining in one place and wearing grooves in the journals. The commutator-brushes also do not bear always on the same part of the commutator-cylinder, and hence do not wear away the cylinder in grooves. I provide also tubes or passages leading from the journal-boxes down into the pillow-blocks, so that the oil which accumulates at the ends of the bearings runs down through such passages into receptacles formed for it in the bed-plate, such receptacles being provided with cocks for drawing the oil off when they become full. The balanced supporting of the armature-shaft is preferably accomplished by placing the machine at a slight angle from a vertical position, so that the shaft would tend to slide toward one end, and placing a spring at that end so adjusted as to just balance this sliding tendency. The shaft will then have a slight oscillation, as above explained. The balancing might, however, be done by inclining the machine as before, and so aligning the machine and the engine which drives it that the belt will tend to resist the sliding down of the shaft, the spring being dispensed with. It is evident, however, that the spring is preferable.

In the annexed drawings, Figure 1 is a view in elevation of the machine with the ends of the bearings shown in section; Fig. 2, a view of the spring which presses against one end of the shaft; Fig. 3, a longitudinal section of one of the bearings, and Fig. 4 a cross-section thereof.

A is the field-magnet, and B the armature of the machine. C is the armature-shaft. D D′ are the journal-boxes, and E E are the pillow-blocks. F is the pulley, and G the belt which runs to said pulley from the driving-motor.

The machine is set at an angle from the vertical. I have indicated this in the drawings by the dotted line *x x*, which would represent the floor-line were the inclination produced by raising one end of the bed-plate. It is to be understood, however, that the angle indicated by this line is much greater than that at which the machine is in reality placed, and is shown merely to illustrate the fact that the machine is inclined. The real angle is so small that it could not be shown in a drawing of this size, as the very least inclination of the machine is sufficient to accomplish the desired object; also, it is to be understood that the above is not the method which I prefer to employ for inclining the machine. Preferably one end of the bed-plate is made a trifle thicker than the other, or the pedestal of one journal-box is raised to a slight extent higher than the other, or the inclination is produced in some other manner in the construction of these stationary parts. The inclination of the machine causes a tendency on the part of the shaft to slide down toward the journal-box D′. To balance the shaft against this tendency, the spring *a* is made to bear against the end of the shaft through alternate washers *b b′*, of metal and fiber or leather, the last washer *b′* bearing directly against the end of the shaft. The rod *c* turns through all these washers except the last, and the spring *a* is coiled around this rod between the washers and the collar *d*. The pressure

of the spring upon the shaft is adjusted by turning the rod *c*, it being provided with thumb-screw *e* for this purpose. The spring is thus adjusted to balance the downward tendency of the shaft, and said shaft is thus allowed to move slightly back and forth, with the result already specified. The journal-boxes are made, as usual, in two parts bolted together, and are lined, preferably, with phosphor-bronze *f* and Babbitt metal *g*. From the oil-cups *h h* the oil descends upon the journals and lubricates them evenly in every part. The oil accumulates at the ends of the bearings, and thence runs off through the pipes *i i*, which extend into the hollow pillow-blocks, and drops off into the receptacles *k k*, which are formed for this purpose in the bed-plate, the latter being in the form of an open-ribbed frame, as set forth in my application, Serial No. 99,553. Such receptacles are provided with cocks *l l*, by which the oil is withdrawn.

It is evident that most of the improvements herein described are applicable to machines other than electrical generators.

It is to be understood that all patentable features of invention shown or described, but not claimed herein, are reserved for protection by other patents, and have been or will be embodied in other applications for patents.

What I claim is—

1. In a dynamo-electric machine driven by a belt, the shaft balanced in its bearings, and free to move in either longitudinal direction, substantially as set forth.

2. The combination, with a dynamo-electric machine driven by a belt, of means tending to move the shaft of the machine longitudinally in one direction, and means acting with equal force to move it in the opposite direction, substantially as set forth.

3. The combination, with a dynamo-electric machine driven by a belt, of a spring bearing against an end of the armature-shaft, substantially as set forth.

4. In a dynamo-electric machine driven by a belt, the combination of a spring bearing against an end of the shaft of the machine, and means tending to move said shaft against said spring, substantially as set forth.

5. A belt-driven dynamo-electric machine placed at a slight angle from a vertical position, and provided with means resisting the consequent sliding tendency of the shaft of the machine, substantially as set forth.

6. A belt-driven dynamo-electric machine placed at a slight angle from a vertical position, and provided with a spring bearing against the lower end of its shaft, substantially as set forth.

7. In a dynamo-electric machine driven by a belt, the combination of an adjustable spring bearing against an end of the shaft of the machine, and means tending to move said shaft against said spring, substantially as set forth.

8. The combination, with a dynamo-electric machine, of a bed-plate therefor, formed as an open-ribbed frame, one or more oil-receptacles within said bed-plate, and one or more ducts leading from the journal-boxes to said receptacles, substantially as set forth.

This specification signed and witnessed this 27th day of July, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

EDWARD H. PYATT.

(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 297,584. Patented Apr. 29, 1884.

Fig. 1.

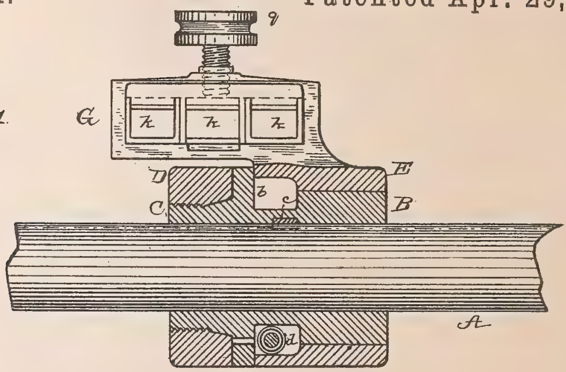


Fig. 3.

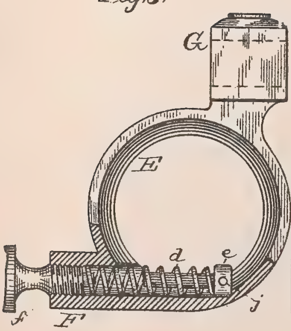


Fig. 2.

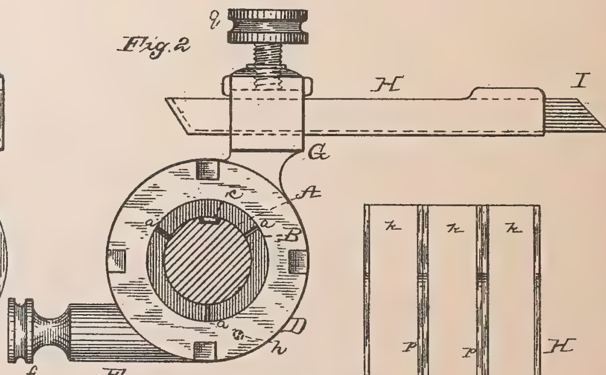


Fig. 6.

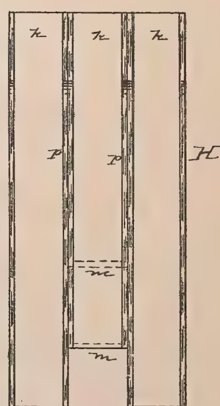


Fig. 4.

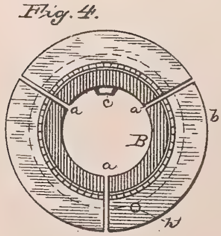
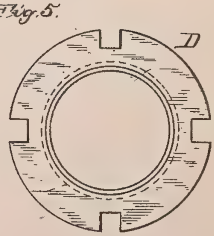


Fig. 5.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd N. Dyer

Atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.)

2 Sheets—Sheet 2.

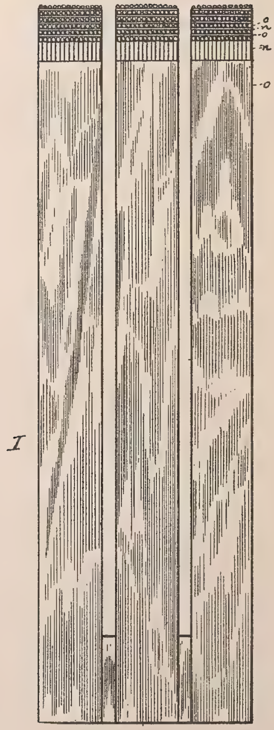
T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 297,584.

Patented Apr. 29, 1884.

Fig. 7.



ATTEST:
E. C. Rowland,
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer,
Atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 297,584, dated April 29, 1884.

Application filed October 10, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines, (Case No. 588,) of which the following is a specification.

This invention relates both to the brush-holders and the brushes themselves of electrical generators and motors. So far as it relates to the former, it is intended as an improvement on the invention set forth in my Patent No. 263,140. As is the case in that patent, I construct the main portion of the holder in two parts, one of which is fixed, while the other, which holds the brush, is held by an adjustable spring-pressure.

The present improvement has for one of its objects to render the brush-holder more compact in form and to conceal and protect the pressure-adjusting devices. The holder is also so constructed that as the end of the brush wears away it can readily be adjusted forward, while at the same time its whole length is well supported. The brush itself is preferably divided longitudinally into several (two or more) parts, so as to diminish spark, and that part of the holder which directly supports the brush is correspondingly divided.

My invention is illustrated in the annexed drawings, in which Figure 1 is a longitudinal section and partial elevation of my improved brush-holder mounted on a shaft or spindle; Fig. 2, an end view of the same holding the brush; Fig. 3, a view of the adjustable and adjusting parts of the holder; Fig. 4, an end view of that part of the holder which is placed on the spindle but with the clamping-ring removed; Fig. 5, a view of the clamping-ring; Fig. 6, a view of that part of the holder in which the brush is directly placed, and Fig. 7 a view of the divided brush.

A is the shaft or spindle, on which one or more brushes, bearing on one side of the commutator-cylinder, are mounted. Upon this spindle is placed a cylinder, B, one end, C, of which is split at *a a*, forming a split sleeve, upon which and against the flange *b* is screwed the ring or collar D, which clamps it upon the shaft. The cylinder B is also provided with a pin or projection, *c*, which enters a slot or groove in the spindle A to keep the cylinder from turning. This cylinder, therefore, forms the fixed portion of the brush-holder.

Upon the cylinder B is placed the adjustable part E, which holds the brush. From the sleeve or collar E a projecting tube, F, extends, in which is placed the spiral spring *d*, which is held between the plate *e* and thumb-screw *f*. The plate *e* bears against the inside of collar E, a depression being formed for this purpose, and plate *e* is connected with cylinder B by a pin, *h*, passing through a hole, *i*, in the split sleeve C into a hole, *j*, in the plate. The cylinder B and collar E are thus connected through the spring *d*, and their relative movement is limited by the spring. The projecting head G also extends from collar E, the collar E, tube F, and head G being all made in one piece. The head G supports the brush-holding frame H, which consists of three parts, *k k*, (or any other suitable number,) attached together, passed through the aperture in the head G and held by downwardly-projecting parts *m m*, one on each side of the head G.

The brush I is composed of layers of wires *n*, alternating with copper strips *o*. Through the greater part of its length it is divided into three parts, and these parts are placed in the three divisions of the frame H, separated by the sides *p* of the divisions. The ends of the brush-sections bear separately upon the commutator-cylinder, thus diminishing the spark. The brush is held by a set-screw, *g*, and by loosening this set-screw the brush may be adjusted forward as the ends of the wires wear away. The use of the alternate wires and strips gives strength to the brush and prevents it from spreading apart.

It will be seen that as the part E turns upon the part B, and the spring *d* bears upon the former, the brush is held against the commutator-cylinder by the spring-pressure, and such pressure is adjusted by means of the thumb-screw *f*. Several of these brush-holders may be placed upon the same shaft or spindle, all being adjustable independently.

What I claim is—

1. The combination, in a commutator-brush holder, of the shaft or spindle, a cylinder fixed thereon, a movable collar concentric to said cylinder and carrying the brush, and adjust-

ing means connecting said collar and cylinder, substantially as set forth.

2. In a commutator-brush holder, the combination of the cylinder fixed upon the shaft or spindle, the movable collar carrying the brush and sleeved upon the fixed cylinder, and the adjustable spring connecting the two parts, substantially as set forth.

3. The combination of the shaft or spindle, the inner cylinder formed as a split sleeve, the clamping-ring, and the outer adjustable collar carrying the brush, substantially as set forth.

4. The combination of the shaft or spindle, the inner cylinder having a pin entering a groove in said shaft or spindle, the clamping-ring, and the outer movable collar carrying the commutator-brush, substantially as set forth.

5. The combination, with the inner cylinder fixed upon the shaft or spindle and the outer movable collar thereon, of the adjustable spring attached to the movable collar, and the pin connecting said spring with the fixed cylinder, substantially as set forth.

6. The combination, with the adjustable collar provided with a projecting tube and the spring within said tube, of the inner fixed cylinder and a connection between the spring and said fixed cylinder, substantially as set forth.

7. The frame carried by the brush-holder and supporting the brush throughout the greater part of its length, substantially as set forth.

8. The combination, with the adjustable cylinder having a projecting head, of the brush-supporting frame carried by such head, substantially as set forth.

9. The combination of the adjustable cylinder having a projecting head provided with an aperture, the brush-supporting frame fixed in such aperture, and the brush held in such frame and adjustable through said aperture, substantially as set forth.

10. The combination of the longitudinally-divided brush and the brush-supporting frame correspondingly divided, the ends of the brush-divisions projecting beyond the frame, substantially as set forth.

11. The commutator-brush composed of alternate metal strips and layers of wires, substantially as set forth.

12. The longitudinally-divided commutator-brush composed of alternate metal strips and layers of wires, substantially as set forth.

This specification signed and witnessed this 8th day of August, 1883.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

INCANDESCING CONDUCTOR FOR ELECTRIC LAMPS.

No. 297,585. Patented Apr. 29, 1884.

ATTEST:
E. C. Rowland
H. W. Seely

INVENTOR:
Thomas A. Edison,
By Richd. N. Dyer,
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

INCANDESCING CONDUCTOR FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 297,585, dated April 29, 1884.

Application filed October 10, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Incandescing Conductors for Electric Lamps, (Case No. 593,) of which the following is a specification.

The object of this invention is to produce incandescing conductors for electric lamps of even size, density, and resistance, and each of which shall be a homogeneous carbon filament. I accomplish this by twisting a strip of paper or other suitable carbonizable material tightly into an even cylindrical filament. I preferably employ a carbonizable cementing material to hold the twisted strip together. The filament thus formed is a homogeneous one, not made up of a number of separate strands, like the conductors of thread which have been sometimes used, while it possesses the advantages of such thread conductors, being cylindrical and of small area and radiating-surface. Being all in one homogeneous piece, all its parts contract and expand evenly, and all are of the same texture and resistance. The strips of paper can be cut with great exactness, so that all will be of precisely the same size, and, being cut from the same quality of paper, very even blanks are produced. Such blanks are then drawn through a die of the desired size and twisted evenly by suitable machinery, so that all the blanks will be twisted to the same extent and all the filaments will be of the same size and density. Preferably the strips of paper are formed with broadened ends, and such ends are also tightly twisted. The carbonizable cementing material binds the filament into a solid mass. Such material is preferably gum-tragacanth or other viscous carbonizable substance, with which the strip is covered before twisting. I may, however, first twist the strip, and then treat the twisted filament with hydrofluoric acid or other gelatinizing agent, gelatinizing a portion of its cellulose, and thus forming the carbonizable cementing material upon and within the filament itself; or the twisted strip might be parchmentized by sulphuric acid or chloride of zinc. The filament, prepared as described, is carbonized in a suitable manner, and may then be attached to leading-in wires and placed in the lamp.

The accompanying drawing represents a paper strip or blank partly twisted. The flat blank, as shown at A, is twisted tightly into the filamentary form shown at B. The blank is formed with enlarged ends *a*, which are twisted into cylindrical form, as at *b*.

What I claim is—

1. The incandescing conductor for an electric lamp, consisting of a carbonized tightly-twisted strip of paper or other suitable carbonizable material, substantially as set forth.

2. The incandescing conductor for an electric lamp, consisting of a carbonized tightly-twisted strip of paper or other suitable carbonizable material provided with a carbonizable cementing material, substantially as set forth.

3. The filament for forming, on carbonization, the incandescing conductor of an electric lamp, consisting of a tightly-twisted strip of paper or other suitable carbonizable material, substantially as set forth.

4. The filament for carbonization, consisting of a tightly-twisted strip of paper provided with a carbonizable cementing material, substantially as set forth.

5. The method of forming incandescing conductors for electric lamps, consisting in twisting a strip of carbonizable material into a homogeneous filament and carbonizing the same, substantially as set forth.

6. The method of forming incandescing conductors for electric lamps, consisting in twisting a strip of carbonizable material into a homogeneous filament, providing it with a carbonizable cementing material, and carbonizing the whole, substantially as set forth.

7. The method of forming incandescing conductors for electric lamps, consisting in twisting a strip of carbonizable material into a filament, treating the same with hydrofluoric acid or other gelatinizing or parchmentizing agent, to form a cementing material, and carbonizing the whole, substantially as set forth.

This specification signed and witnessed this 14th day of September, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

ELECTRICAL CONDUCTOR.

No. 297,586. Patented Apr. 29, 1884.

Fig. 1.

Fig. 2.

Fig. 3.

ATTEST:

Edw. H. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd N. Dyer,
Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRICAL CONDUCTOR.

SPECIFICATION forming part of Letters Patent No. 297,586, dated April 29, 1884.

Application filed October 10, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electrical Conductors, (Case No. 596,) of which the following is a specification.

The object of this invention is to effectively insulate electrical conductors, the mode of insulation being especially adapted for conductors which are to form the inductive portions of the rotating armatures of dynamo-electric machines.

The invention consists, mainly, in the use of parchment-paper provided with a retaining-covering of fibrous material, braided, wound, or otherwise formed thereon. The parchment-paper may or may not be covered with Japan varnish. Being non-porous, this insulation does not allow the electricity to penetrate through it, and it is also a good conductor of heat, which it conveys from the armature coils or bars. Parchment-paper used alone possesses these characteristics to a degree practically sufficient, though the japanning of the paper increases them to some extent. I take a continuous strip of the parchment-paper and wind it spirally upon the conductor with the edges of the strip overlapping, so as to completely cover said conductor. The retaining-covering is of any suitable fibrous material, and is preferably braided tightly upon the parchment-covered conductor, though it may be wound thereon or otherwise applied. It keeps the parchment-paper in place and prevents it from unwinding from the conductor. Wire of any size, or the copper inductive bars used in large machines, may be insulated in this way, or a number of wires forming one conductor may be included in the same wrapping.

In the accompanying drawings, Figure 1 represents the wire wound with the spiral strip of parchment-paper; Fig. 2, the same with the retaining-covering braided thereon, and Fig. 3 an enlarged section of the complete insulated conductor.

A is a wire upon which is spirally wound the parchment-paper B, and over this is braided the retaining-covering C.

What I claim, is—

1. The combination, with an electrical conductor, of a strip of parchment-paper wound spirally thereon, and a braided or wound retaining-covering, substantially as set forth.

2. As an insulator for electrical conductors, japanned parchment-paper, substantially as set forth.

3. The combination, with an electrical conductor, of a strip of japanned parchment-paper wound spirally thereon with its edges overlapping, and a retaining-covering, substantially as set forth.

This specification signed and witnessed this 14th day of September, 1883.

THOS. A. EDISON.

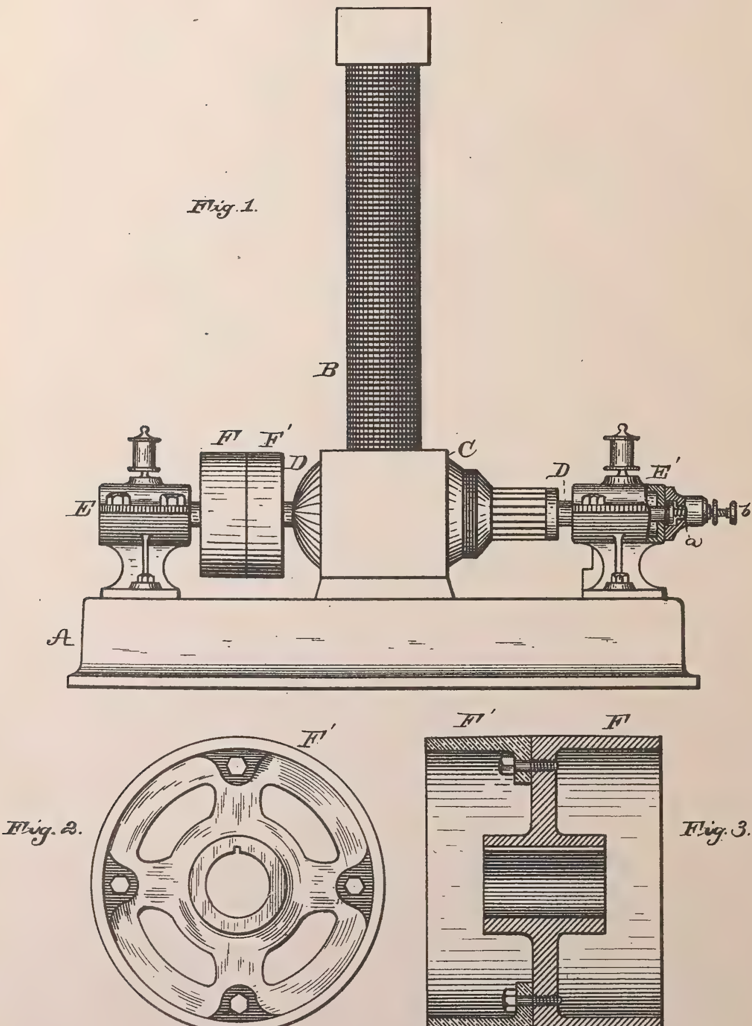
Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 297,587. Patented Apr. 29, 1884.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Rich'd N. Dyer

Atty.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 297,587, dated April 29, 1884.

Application filed December 12, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines, (Case No. 597,) of which the following is a specification.

In my application No. 587 (Serial No. 108,556) I have set forth means for balancing the armature-shaft of a dynamo-electric machine in its bearings, so that it is free to move longitudinally in either direction, whereby the efficient lubrication of the bearings and the even wearing of the journals and the commutator-cylinder are secured.

This invention relates to other means for accomplishing the same object. In the present case, as in that above referred to, I prefer to use a spring bearing against an end of the armature-shaft to produce the tendency in one direction of the shaft; but to balance this tendency I make use of the magnetic attraction of the field-magnet of the machine by so placing and constructing the driving-pulley that said pulley is nearly removed from the magnetic field, the attraction between the magnet-poles and the pulley sufficing merely to produce enough opposing tendency to the spring to balance its pressure. To accomplish this I prefer to make the pulley partly of magnetic and partly of non-magnetic material, the magnetic part being so proportioned and located that its attraction toward the poles will suffice to produce the result above specified. The shaft, being thus balanced, oscillates slightly in its bearings. The lubricating-oil is thus spread evenly upon the bearings, and grooves are not worn in the journals by grit or hard particles, which may enter them, or on the commutator-cylinder by the brushes.

Instead of the spring bearing against the end of the shaft, other means may be employed to balance the attraction of the magnet-poles. The machine might be set at a very slight inclination to produce a tendency for the shaft to slide slightly downward; or the alignment of the machine and its driving-motor might be such that the draft of the belt will oppose the magnetic attraction.

My invention is illustrated in the accompanying drawings, in which Figure 1 is a view of a dynamo-electric machine embodying said invention; Fig. 2, an end view of the driving-pulley, and Fig. 3 a section thereof.

A is the bed-plate, B the field-magnet, C the armature, and D the armature-shaft, of a dynamo-electric machine. The shaft is supported in journal-boxes E E′. In the box E′ is placed a spring, *a*, which presses against the end of the shaft D, and whose tension is adjusted by means of set-screw *b*. The driving-pulley on the armature-shaft is made in two parts, bolted together—one, F, of iron or other magnetic metal, the other, F′, of brass or other non-magnetic material. Preferably the magnetic portion F is placed on the side away from the magnet, so as to remove it farther from the magnetic field; but if it is made smaller it may be placed nearer the magnet. The attraction between the field-magnet poles and the part F of the pulley balances the pressure of the spring on the shaft, and the shaft is thus free to slightly oscillate longitudinally in its bearings.

What I claim is—

1. The combination, with a dynamo-electric machine, of means opposing the attraction of the driving-pulley by the field-magnet of the machine, substantially as set forth.

2. The combination, with a dynamo-electric machine, of a spring bearing on the end of the armature-shaft and opposing the attraction of the driving-pulley by the field-magnet, substantially as set forth.

3. The combination, with a dynamo-electric machine, of a driving-pulley nearly removed from the attraction of the field-magnet, and means opposing the slight attractive influence of said magnet upon said pulley, substantially as set forth.

4. The combination, with a dynamo-electric machine, of a driving-pulley partly of magnetic and partly of non-magnetic material, substantially as set forth.

5. The combination, with a dynamo-electric machine, of a driving-pulley partly of magnetic and partly of non-magnetic material, and means opposing the attraction of the

field-magnet for said pulley, substantially as set forth.

6. The combination, with a dynamo-electric machine, of a driving-pulley partly of magnetic and partly of non-magnetic material, and a spring opposing the attraction of said pulley by the field-magnet of the machine, substantially as set forth.

This specification signed and witnessed this 15th day of November, 1883.

THOS. A. EDISON.

Witnesses:

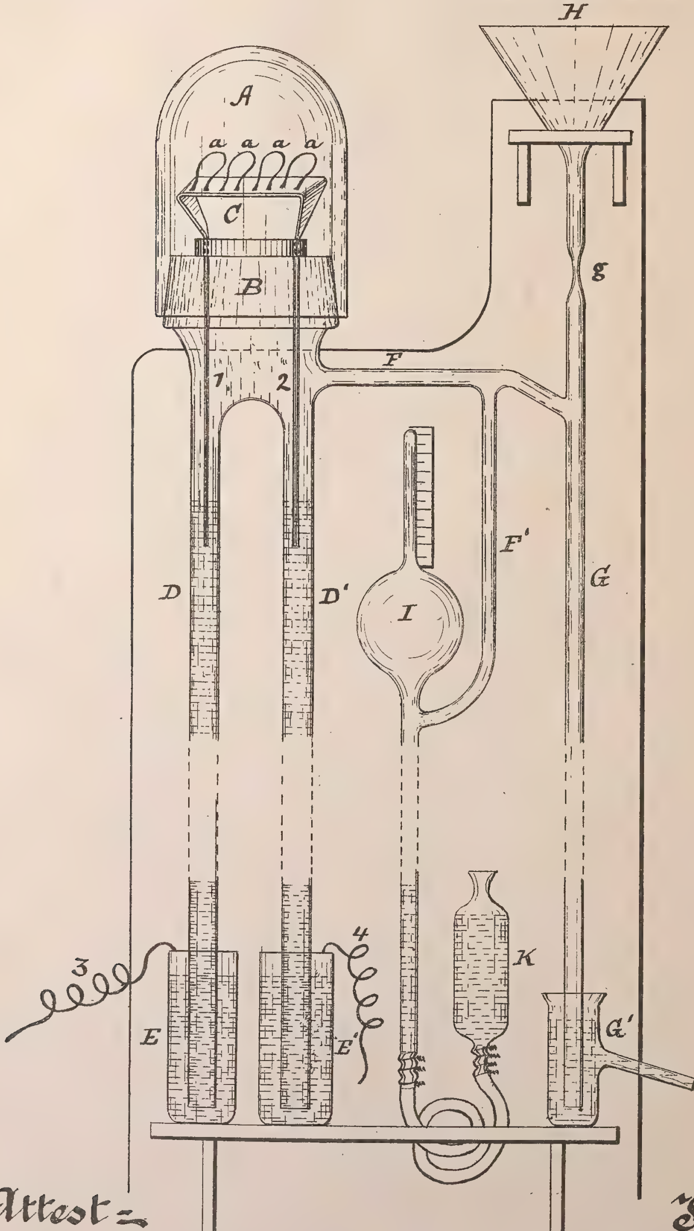
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

METHOD OF TREATING CARBONS FOR ELECTRIC LIGHTS.

No. 298,679. Patented May 13, 1884.



Attest:
Sam. D. Mott
James A. Payne

Inventor:
Thos. A. Edison
per. Dyer and Wilber
Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

METHOD OF TREATING CARBONS FOR ELECTRIC LIGHTS.

SPECIFICATION forming part of Letters Patent No. 298,679, dated May 13, 1884.

Application filed July 3, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Method of Treating Carbons for Electric Lights, (Case No. 221;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

As described in prior applications for patents by me made for improvements in electric lights, wherein the light is produced by an incandescent conductor hermetically sealed in a glass globe, the body of the incandescent conductor or carbon is very small—a mere filament or thread—but with enlarged ends for the purpose of affording better contact with the clamps. Preferably these carbons, of horseshoe form, are made of one piece of material, the entire device, body, and thickened ends being unitary and homogeneous, cut or shaped from suitable material and then carbonized. The carbonization is done in a nickel flask, the filamentary bodies being satisfactorily carbonized therein. It sometimes happens, though, that the broad ends are not thoroughly carbonized, as, owing to their greater mass the flasks would melt before the ends had reached thorough carbonization. It is essential that there should be thorough carbonization of every portion of the carbon, that every atom of hydrocarbon should be changed to carbon. If this be not done, the heat and high vacuo to which they are subjected in the lamp gradually throws out any unchanged hydrocarbon, eliminating it from the carbon and causing a deposit on the glass of a hydrocarbon. It is desirable, therefore, that the carbons should be treated by some process which will result in their entire and complete carbonization, and the object of this invention is to furnish a process or method for accomplishing that result. This method consists in subjecting the thickened ends only, but not the bodies, of the carbons, after carbonization in flasks, to a high heat *in vacuo*.

In the drawing is shown means by which this method may be readily practiced, the drawing being a front view of the apparatus necessary therefor.

B is a base of insulating material, preferably of glass, upon which rests the globe A, the two being so fashioned that their joint is air-tight, the glass surfaces being ground true for this purpose. I do not, however, claim herein the lamp of this construction, since I propose to cover it by a separate application for patent.

Attached to B hermetically are the tubes D D′, of a length somewhat greater than the height of a mercury column *in vacuo*, dipping in their lower ends in the mercury-reservoirs E E′, which seal their lower ends.

Passing through the base B are conductors 1 2, whose lower ends pass into the tubes D D′, reaching a short distance below the top of the mercury columns, and whose upper ends are united by a conductor, C, of a material capable of being rendered incandescent by an electric current—preferably platinum—and broadened on top, so as to form a seat or platform, on which carbon horseshoes may be laid.

From the body formed by the union of the two tubes D D′ a passage, F, leads to the pump, by which the air is exhausted. The pump herein shown is an exceedingly simple one, although any other suitable form of air-exhausting pump may be used. The pump consists simply of a long tube, G, whose lower end dips into a mercury-vessel, G′, provided with an overflow-spout, the upper end being formed into or provided with a mercury-reservoir, H. At a little distance from its upper end the tube G is contracted into a very narrow orifice, *g*, of a size which permits the mercury to fall through drop by drop. At a little distance below *g* the tube F enters G by a downward bend.

Connected to the tube F by tube F′, so as to be in connection with the pump and with the vessel under operation of the pump, is a McLeod gage, I, for determining the degree of exhaustion in A.

In carrying the method into practice the operation is as follows: Upon the platform C are laid the broad ends of a series of carbon horseshoes, *a a a a*, and the globe A placed

on the base B, so that the joint between them is air-tight. The vessels E E and H being filled with mercury, the mercury dropping through *g*, each drop passing the tube F carries a modicum of air with it. As the air is exhausted from A and the tubes D D′ the mercury rises in the latter until, when the proper degree of exhaustion is reached, the mercury rises and contacts with 1 2. The circuit from a source of electric energy passing by 3 to E D 1 C 2 D′ E′ 4 is closed, the platinum C being thereby rendered incandescent, imparting its heat by conduction to the broad ends of the carbons *a a*. These broad ends are kept subject to this heat *in vacuo* until it is judged that they are thoroughly and evenly carbonized, the body of the carbons, on account of the poor heat-conducting qualities of the carbon, remaining unheated comparatively. When the carbons have been thus treated *in vacuo* sufficiently, the shade A is lifted off and the carbons removed and placed in lamps, where they are again subjected to heat in the process of exhausting the air, as detailed in a prior application.

Instead of being heated while *in vacuo* by an electric current, as here described, I have found that the same result may be attained by throwing upon their broad ends the rays of the sun properly focused, so as to raise them to a very high red or to a white heat while *in vacuo*. For this purpose I have used an apparatus like that shown, combined with a heliostatic arrangement adjusted to carry the lens, so that its focus shall remain at the proper spot.

The pump herein shown and described is given as showing means for carrying the invention herein claimed into practice; but no claim is now made to the pump, as such pump will form the subject of a separate application.

It will be seen that the parts shown at the left of the figure, which are connected with the pump by the glass tube F, form an incandescing electric lamp, and can be employed as such independent of their use in the method before described.

The lamp can be disconnected from the pump, as will be readily understood, by "sealing off" the tube F, and the vacuum will be maintained within the lamp by the ground-glass union or joint at the junction of the globe and base.

What I claim is—

1. The method of preparing carbons for incandescing electric lamps having broad or enlarged ends, consisting in first carbonizing the filament, converting its body into carbon, and then subjecting the broad ends or enlarged portions to the action of heat *in vacuo*, substantially as set forth.

2. The combination of a vacuum-chamber, a platform therein for the carbons, an exhausting apparatus, and means for imparting a high heat to the broad ends of the carbons while *in vacuo*, substantially as shown and described.

This specification signed and witnessed this 15th day of June, 1880.

THOMAS A. EDISON.

Witnesses:
S. L. GRIFFIN,
WM. CARMAN.

(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 298,954. Patented May 20, 1884.

Fig. 1.

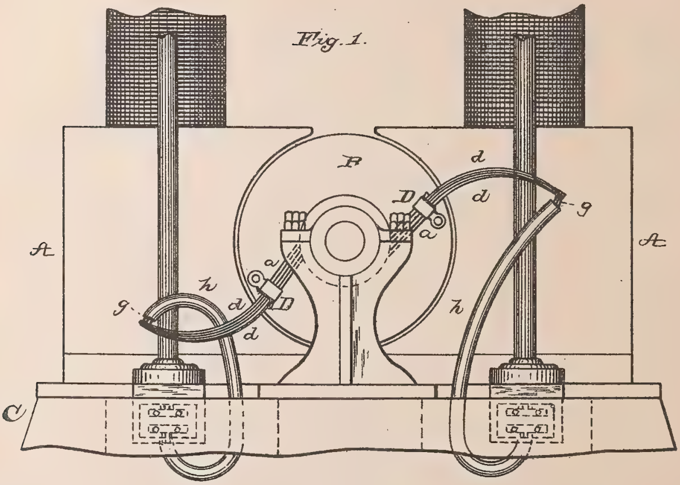


Fig. 2

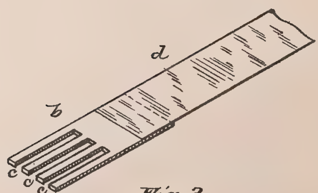


Fig. 3.

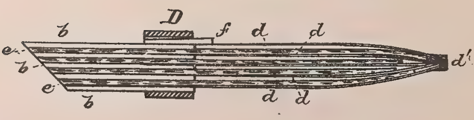
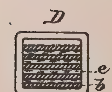


Fig. 4



ATTEST

Edw. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison,

By Richd N. Dyer

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 298,954, dated May 20, 1884.

Application filed December 12, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines, (Case No. 600,) of which the following is a specification.

In my Patent No. 276,233, dated April 24, 1883, are set forth the advantages of the use of current-collectors forming bridges of high resistance between the bars of the commutator-cylinder of a dynamo-electric machine or electro-dynamic motor, whereby the spark at the commutator-bars, due to the breaking of local circuits, is prevented, and in said patent is described the use for this purpose of current-collectors of inferior conducting capacity, making inferior contact at the surface of the commutator-cylinder.

My present invention relates to a different means of forming such high-resistance connections between the commutator-bars. Instead of making inferior contact at the commutator-cylinder, or forming the current-collector of inferior conducting material, I place the desired high resistance external to the current-collector, between it and the point of connection with the main conductor leading from the machine. I do this by using a divided commutator-brush composed of alternate layers of metal, preferably copper, and insulating material, and connecting all the metallic layers together through external conductors having the desired high resistance. The local current then, which passes through the brush from one commutator-bar to another, encounters the resistance of these separate conductors, having to pass through them to and from their point of connection together; and, therefore, as explained in the patent above referred to, this local current will be weak and the breaking at the surface of the cylinder of the local circuit will produce little or no spark.

My invention is illustrated in the annexed drawings, in which Figure 1 is a view in elevation of a portion of a dynamo-electric machine embodying said invention; Fig. 2, a view of one of the strips of the commutator-brush with the resistance-conductor attached thereto; Fig. 3, a side view of the brush and resistance-conductor with the clamping-sleeve in section, and Fig. 4 a cross-section of the brush.

A A are the field-magnet poles of a dynamo-electric machine or electro-dynamic motor. B is the armature thereof, and C the bed-plate, the lower portion of which is broken away in the drawings.

The commutator-brushes *a a* are each formed of several strips, *b*, of copper or other suitable metal, whose bearing ends are preferably divided by several slots or notches, *c c*, to divide and diminish spark at the ends.

To each metal strip *b* is attached a thin strip of metal, *d*. This may be copper, in which case it would be made of the desired resistance by properly proportioning its length and sectional area; or a strip of German silver or other high-resistance metal may be used, which would of course be larger and shorter than a copper strip. The ends of all these strips are soldered together at *d'*.

Between the metal strips of the brush are placed layers *e* of insulating material. Mica or asbestus is a suitable material for this purpose. The insulating-layers extend back close to the ends of the resistance-strips, and such ends are soldered together, and are all connected to the main conductor. Around the brush, at the outer end of the bearing-strips, is placed a sleeve of insulating material, which holds the metal and insulating-strips together, a wedge, *f*, of wood or other suitable material, being inserted within the sleeve to secure the whole tightly.

Instead of a single bearing-strip, *b*, with its end divided into fingers, several separate strips or wires may be secured to the resistance-strip *d*. The insulating-strips *e*, preferably, but not necessarily, are similarly divided. The ends of all the metal strips bear upon the commutator-cylinder, and the local circuit formed when the brush bridges the commutator-bars is around the outer end of the resistance-strips.

Any suitable number of current-collectors to produce the total conductivity required may be used on each side of the commutator-cylinder.

The circuit-connections from the ends of the resistance-strips are preferably made in the

manner shown, conductors g extending through insulating-tubes h to clamping-plates on the bed-plate of the machine.

It is evident that many details—such as the form and arrangement of the external resistances—may be modified without departing from the spirit of my invention.

What I claim is—

1. An electrically-divided current-collector each of whose divisions is of such width as not to bridge the space between the commutator-bars, in combination with a resistance external to said brush, forming a high-resistance bridge between said bars, substantially as set forth.

2. The current-collector formed of alternate layers of metal and insulation, in combination with resistances external to said current-collector through which the metal layers are connected, substantially as set forth.

3. The combination of the metal-bearing strips or wires of a current-collector, resistances attached thereto and connected together and to the main conductor, and insulating material between the bearing ends and between the resistances, substantially as set forth.

4. The combination, with the metal bearing-strips and the interposed insulation, of the insulating-sleeve holding them together, substantially as set forth.

5. The combination, with the metal bearing-strips and the interposed insulation, of the insulating-sleeve and wedge holding them together, substantially as set forth.

6. The current-collector formed of strips of metal and interposed insulation, in combination with resistance-strips attached at one end to said metal strips, and all connected together at their other ends, substantially as set forth.

This specification signed and witnessed this 15th day of November, 1883.

THOS. A. EDISON.

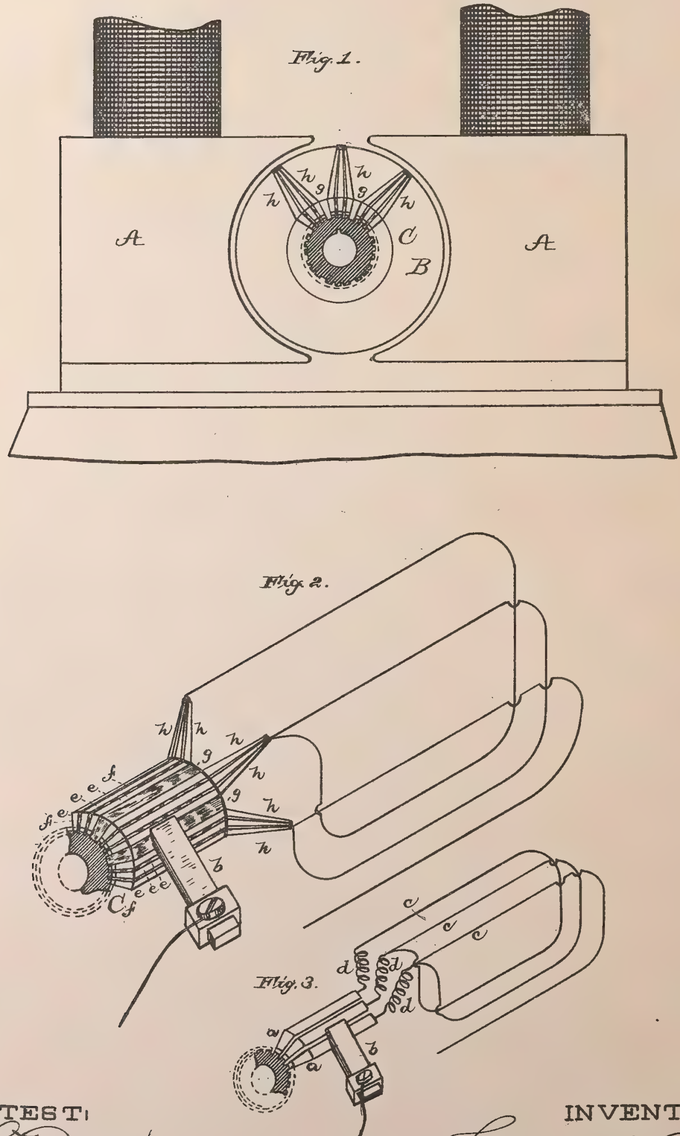
Witnesses:
H. W. SEELY,
EDWARD H. PYATT.

(No Model.)

T. A. EDISON.

DYNAMO ELECTRIC MACHINE.

No. 298,955. Patented May 20, 1884.



ATTEST:

E. C. Rowland

H. W. Seely

INVENTOR:

Thomas A. Edison

By Rich'd N. Dyer

Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 298,955, dated May 20, 1884.

Application filed December 12, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines, (Case No. 601,) of which the following is a specification.

In my Patent No. 276,233 is set forth the use of current-collectors for electrical generators and motors of high resistance, whereby the local current set up when a current-collector bridges the commutator bars is weak, and little or no spark is produced by the breaking of the local circuit.

This invention relates to a different means for producing the same result; and it consists, mainly, in the use of connections of high resistance between the commutator-bars and the armature-coils of dynamo-electric machines and electro-dynamic motors; and it further consists in making this connecting resistance variable, so that a greater resistance is in the local circuit when the brush leaves a bar than when it is resting on said bar, this being accomplished by dividing each commutator-bar into several parts, all the parts of each bar being connected separately to the same coil of the armature, so that only one connection, and consequently the highest resistance, is interposed in the local circuit at the moment when the current-collector leaves the bar, whereby the spark is much lessened or entirely done away with.

The above may be better understood by reference to the annexed drawings, in which Figure 1 is a view in elevation of a portion of a dynamo-electric machine embodying my invention, the commutator-cylinder being in section. Fig. 2 is a view of a part of the commutator-cylinder, with a diagram of the armature-coils; and Fig. 3, a similar view illustrating the simplest form of the invention.

Referring first to Fig. 3, *a a* represent conducting-bars on the commutator-cylinder of a dynamo-electric machine. A commutator-brush, *b*, rests upon the bars. *c c* are coils upon the armature of the machine, and the connections of these coils with the respective commutator-bars are made through resistances *d d*. These resistances may be in the form of coils of wire, or thin strips of German silver, or other high-resistance metal; or any other suitable material in convenient form may be employed. The local circuit formed when the brush bridges two commutator-bars must include two of these resistances *d*, and consequently a weak current only can be generated in such circuit, incapable of producing any considerable spark when the circuit is broken.

Referring now to Figs. 1 and 2, A A are the poles of the field-magnet, and B is the armature of a dynamo-electric machine. C is the commutator-cylinder. Each of the ordinary bars upon its surface is divided into three parts, *e e e*, separated by mica, *f*, or other suitable insulation. Mica insulation *g* separates the divided bars from one another. All the divisions of a bar are connected at the same point to the armature-coils, the connections preferably being through resistances. Strips *h*, of German silver, are shown for forming these connections. These strips are attached to the commutator-bars, and the armature-coils to the strips in any suitable manner. When the brush *b* bears on all the divisions of a commutator-bar, the three connecting-strips *h* of that bar are all in circuit; but when it is upon the last division alone only one connecting-strip is in circuit, so that a high resistance is in circuit at the time when the circuit is broken by the brush leaving the last division of the bar.

I do not claim herein the use of resistances external to or separate from the current-collectors, forming bridges of high resistance between the commutator-bars, for this forms the subject of my application No. 600, (Serial No. 111,281.)

What I claim is—

1. In a dynamo-electric machine, the combination, with the commutator-bars and the armature-coils, of high-resistance connections between them, substantially as set forth.

2. In a dynamo-electric machine, the combination, with the commutator-bars and the armature-coils, of connections between them of varying resistance, the highest resistance being in circuit when the current-collector leaves a bar, substantially as set forth.

3. In a dynamo-electric machine, the divid-

ed commutator-bars, all the divisions of a bar being connected at the same point to the armature-coils, substantially as set forth.

4. In a dynamo-electric machine, the combination, with the armature-coils and the commutator-bars, of connecting-strips of high-resistance material between them, substantially as set forth.

5. In a dynamo-electric machine, the combination of the divided commutator-bars, the armature-coils, and the connecting-pieces of high-resistance material, all the divisions of a bar being connected at the same point to the armature-coils, substantially as set forth.

This specification signed and witnessed this 15th day of November, 1883.

THOS. A. EDISON.

Witnesses:

H. W. SEELY,

EDWARD H. PYATT.

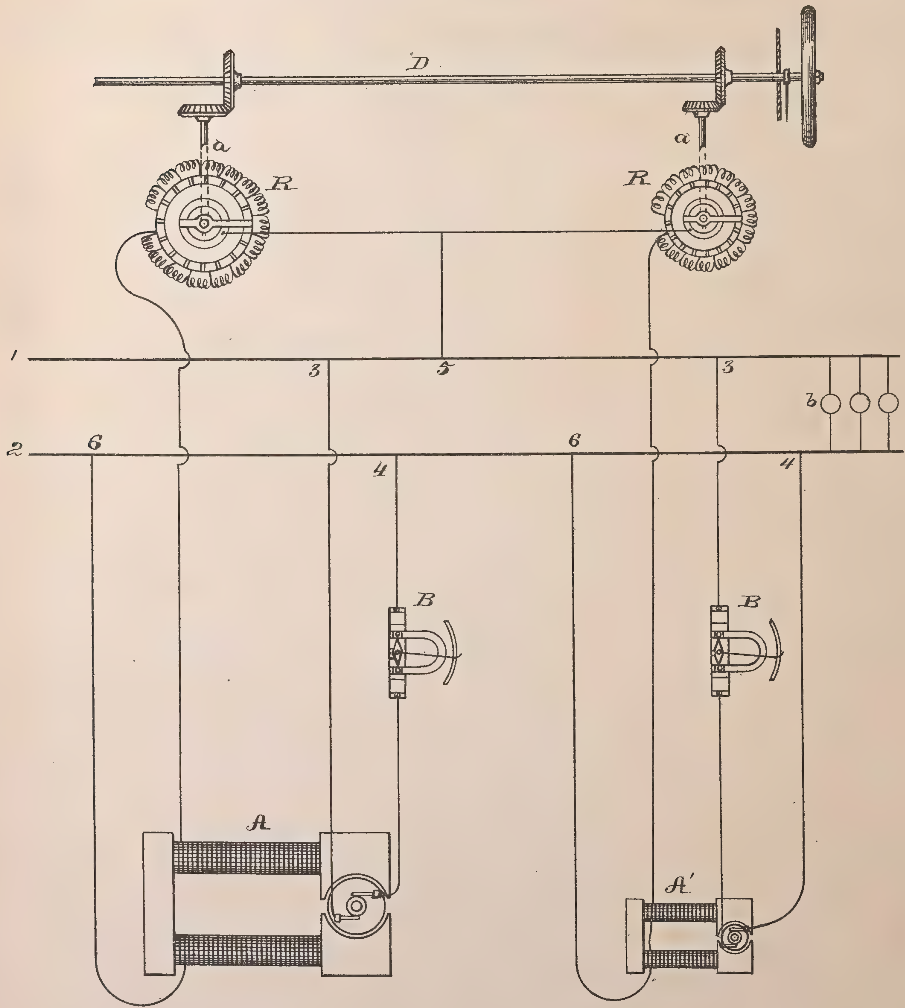
[illegible]

(No Model.)

T. A. EDISON.

MODE OF OPERATING DYNAMO ELECTRIC MACHINES.

No. 298,956. Patented May 20, 1884.



WITNESSES:

E. C. Rowland

H. W. Seely

INVENTOR:

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By Richd. N. Dyer

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

MODE OF OPERATING DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 298,956, dated May 20, 1884.

Application filed January 24, 1884. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Dynamo-Electric Machines and Methods of Operating the Same, (Case No. 612,) of which the following is a specification.

This invention relates to systems of electrical distribution in which two or more electrical generators are connected in multiple arc to the same main conductors.

Heretofore it has not been found practicable to use together two generators having the same electro-motive force but of different generative capacity, for the reason that, as the current is proportional to the electro-motive force and resistance, the entire current generated tends to divide itself equally between the two machines, and the smaller machine having armature-coils of less radiating capacity is unequal to the work put upon it, and has its coils injured or burned out by the excessive current which traverses them. I have often found it necessary or convenient to use machines of different capacity in connection with the same circuit. For instance, in a plant of fifteen hundred incandescent lights it might be desired to use a one-thousand-light and a five-hundred-light machine to produce the necessary quantity of current, and in some plants I may wish to keep small machines as spare machines, which are thrown into circuit when an unusual load is put upon the generating-station. To provide for such instances as these I have devised a method of operation which allows the running of two unequal machines in multiple arc from the same circuit. I do this by regulating the electro-motive force of the machines until each machine gives its proper proportion of the entire current generated. I employ indicators of ampères of current, one for each machine, whereby I can determine what current each machine is giving, and I adjust the electro-motive force (which can be done in various ways) until the indicators show the right proportion for each machine. The machines are then regulated together and in the same proportion according to variations in the current required. Where the load is constant, of course no such regulation is necessary. The way in which I prefer to vary the electro-motive force of the machine is by adjusting resistances in their field-magnet circuits. The resistance for each machine has its coils proportioned to the generative capacity of the machine. I prefer to have the resistance-arms detachably connected together, so that they can be worked alone or simultaneously. When the machines are first placed in circuit, I disconnect the arms and adjust the resistances until the ampère-meters show the right proportions. I then reconnect the arms and adjust the resistances together according to variations in the load. The reduction of electro-motive force for the smaller machine may, however, be accomplished by running it at a somewhat lower speed than the other, or in any other suitable way. The small machine, running at lower electro-motive force, does less work than the larger in the proportion of their respective capacities. The commutator-brushes are kept adjusted to the point of least spark, as such point varies with the load upon the machine. It is evident that in some cases it may be desirable to regulate the electro-motive force of only one of two machines in order to properly proportion the two.

The accompanying drawing is a diagram illustrative of the invention.

A and A′ represent two dynamo-electric machines of unequal generative capacity. Their armatures are connected in multiple-arc circuits 3 4 with the main conductors 1 2, and the field-magnets are placed in other circuits, 5 6.

B B are indicators of ampères of current. Any ampère-indicators may be employed—for instance, that set forth in my application No. 611, (Serial No. 118,543.) In each field-circuit is an adjustable resistance, R. The adjusting-arms are connected detachably with spindles *a a*, which are revolved by the shaft D. The resistances are disconnected and adjusted until the indicators B show the right proportion, and then, the resistance-coils being relatively proportioned, as shown, according to the capacity of the machines in connection with which they are used, they are connected again with the shaft and may be ad-

justed simultaneously if variations occur in the number of translating devices b b in circuit.

I do not claim herein the ampère-indicator in the armature-circuit of each machine, as this is claimed in my application No. 605, (Serial No. 114,283.)

What I claim is—

1. The combination of two machines of different generative capacity connected in multiple arc with the same circuit, and having their respective electro-motive forces adjusted as described, substantially as set forth.

2. The combination of dynamo-electric machines of different generative capacity connected in multiple arc with the same circuit, and means for regulating the electro-motive force of one or more or all of said machines, substantially as set forth.

3. The method of operating dynamo-electric machines of different generative capacity in multiple-arc connection with the same circuit, consisting in adjusting the electro-motive force of one or more or all of said machines until each gives its right proportion of the entire current, substantially as set forth.

4. The method of operating dynamo-electric machines of different generative capacity in multiple-arc connection with the same circuit, consisting in separately adjusting their electro-motive force until each gives its right proportion of the entire current, and then adjusting their electro-motive force simultaneously according to variations in the common load, substantially as set forth.

5. The combination of dynamo-electric machines of different generative capacity connected in multiple arc with the same circuit, and an adjustable resistance in the field-circuit of each, the coils of the resistances being proportioned to the machines, and said resistances being adjustable separately or simultaneously, substantially as set forth.

This specification signed and witnessed this 5th day of January, 1884.

THOS. A. EDISON.

Witnesses:
WM. H. MEADOWCROFT,
H. W. SEELY.